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SALMON FISHERIES (ENGLAND AND WALES).

TWENTY-FOURTH ANNUAL REPORT

OF THE

INSPECTOR OF FISHERIES (ENGLAND AND WALES).

(For the Year 1884.)

*Presented to both Houses of Parliament by Command of Her Majesty.
(Pursuant to 24 & 25 Vict. c. 109. s. 32.)*



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REPORT.

SIR,

Home Office, April 30th, 1885.

IN laying before you my Annual Report on the Salmon Fisheries of England and Wales for the year 1884, I have the honour to state that the returns furnished by the clerks to the various Boards of Conservators under the provisions of section 63 of the Salmon Fishery Act, 1873, show that the fishing season of 1884, although not so productive, generally speaking, as that of 1883, when the salmon harvest was unusually abundant, was not, so far as the "commercial" fisheries are concerned, uniformly inferior to its predecessor, though the interests of "sport" in almost every river suffered in consequence of the drought.

Results of the
Fishing Season
of 1884.

A dry year is naturally unfavourable to the angler, since one of the principal inducements to the salmon to enter the fresh water is absent. On the other hand, the net fishermen in the sea and estuaries have a practical monopoly of the fish. Under certain conditions, however, the sea fishings may be injuriously affected by the occurrence of a prolonged drought; and in several rivers, in which a productive season might have been anticipated, the net fisheries show a falling off. This is notably the case in the Tyne, to which I referred in my last report as a striking exception from the general record of an increased take of salmon in 1883, and which again shows a further falling off in the yield of its net fisheries in 1884. It is quite possible that the pollutions poured into the mouth of the Tyne, being in a more than usually concentrated form, owing to the absence of floods, may have had the effect of keeping the fish further away from the most productive fishing grounds near the mouth of the river; but in the case of rivers like the Clwyd and Elwy and the Dart, where no serious pollutions exist, the falling off which is reported to have occurred in the net fisheries cannot be accounted for in that way. Local variations in the extent and the periods of rainfall may account for the different experiences of the net fisheries in widely separated districts; but it is difficult to explain such contradictory evidence as to the effect of a year of great drought as that afforded by rivers so similarly circumstanced as the Usk and the Wye, whose reports as to the catch of salmon last year are as follows:—In the Usk the take in the tidal waters was larger, and in the fresh waters smaller, than in 1883, the gross result being "probably about the same;" on the other hand, in the Wye, the take in the tidal waters and the lower portion of the fresh waters decreased, while in the upper fresh water fisheries the take of salmon in 1884 was so much larger than in 1883, that on the whole the take of salmon in 1884 shows an increase over the previous year.

The Usk and the Wye rise in the same mountain, flow through an expanse of country of much the same nature, and fall into the

Bristol Channel within a few miles of each other. Neither river is polluted; each is free from obstructions; both are fished near the mouth with engines of the same character; and the only difference is that, whereas net fishing is allowed in the fresh waters of the Wye, it is practically prohibited in those of the Usk. The only effect of this difference, however, is that many of the fish which escape the putts and putchers at the mouth of the Wye fall a prey to the nets above, while those that escape the putts and the putchers at the mouth of the Usk are reserved for the rods. In a dry season rod fishing is difficult, if not impossible; the fish may be in the river, but they are not caught; whereas if there are any fish in the river at all some of them are sure to fall a prey to the nets. Hence the fact that the rod fishing in the Usk last year was poor is not an absolute proof that fish were scarce, and it may be reconciled with the fact that the produce of the net fishing in the fresh waters of the Wye was larger in 1884 than in 1883. But the remarkable circumstance is that, while the fishing in the tidal waters of the Usk was more productive, the fishing in the tidal waters of the Wye was less productive, in 1884 than in 1883.

How this almost unique experience of the Wye can be accounted for, I will not attempt to inquire here. It certainly shows that a year of drought is not necessarily an advantage to the tidal fisheries, or a disadvantage to the non-tidal fisheries.

Not less contradictory is the experience of two rivers flowing into a common estuary in South Devon, viz., the Tamar and the Tavy, both running into Plymouth Sound. The take of salmon in the Tavy is reported by the Board to have been in "excess of" "any they have known for years," and this report apparently applies to fresh waters as well as to tidal waters; whereas in the other rivers of the district the take last year was smaller than in 1883.

The usual result of the year's fishing, however, was either a general decrease in the supply of fish, or an increase in tidal waters accompanied by a falling off in fresh waters; and the only other rivers in which an increase in the take in fresh waters occurred are the Cleddy, where an increase in fresh waters is specially noted (the return being silent as to tidal waters); the Teify, where an increase in tidal waters was accompanied by a take in fresh waters about equal to that in 1883; and the Trent, which enjoyed the exceptional good fortune of an increase in both.

In the West Cumberland district, an increase of the take in tidal waters was accompanied by so great a diminution in the fresh waters that the nett result was a falling off from the record of the previous year; but, in the following districts, the falling off in the fresh waters was not sufficient to nullify the increase in tidal waters, the gross return being equal to, or even in the cases marked * better than, that of 1883:—

* Kent and Leven.

Lune.

Dee.

* Seiont.

Ayron.

* Teign.

* Esk (Yorks).

* Tees.

The report of the Camel Board, while not making any comparison between the produce of the two years, states that, "in consequence of the drought during the summer of 1884, many salmon peal were netted in the lower portions of the Camel; and the bright weather and small water interfered with the rod and line fishermen."

In the Eden district the take of salmon last year is reported to have been about "an average"; in the Dovey, Taff and Ely, and Otter districts the take was much the same in 1884 as in 1883; while in the Exe the fish, though not increased in number, were of a larger size.

Of the remaining districts the following report that the gross take was smaller than in 1883:—

Ribble.
Clwyd and Elwy.
Conway.
Dwyfach.
Towy.
Ogmore.
Severn.
Avon, Brue, and Parret.
Taw and Torridge.

Fowey.
Avon and Erme.
Dart.
Axe.
Avon and Stour.
Yorkshire.
Tyne.
Coquet.

For the following seven districts, viz., the Derwent (Cumberland), Rhymney, Frome, Ouse (Sussex), Rother, Stour (Kent), and Wear, no returns are available.

The returns of the number of boxes of salmon sold at Billingsgate, which have again been furnished to me by Messrs. W. Forbes Stuart & Co., of Lower Thames Street, support the conclusion that on the whole the English and Welsh salmon harvest of 1884 was not so large as that of 1883. The following are the figures for the last 10 years:—

RETURN of BOXES of SALMON SOLD at BILLINGSGATE (each box weighing about 1 cwt.).

Year.	Scotch.	Berwick-on-Tweed.	Irish.	English and Welsh.	Dutch.	Sweden and Norway.	American.	Total Boxes.	Total Weight. Tons.	
1874	-	32,180	1,124	6,041	1,602	1,491	652	--	41,966	2,098
1875	-	20,375	782	5,784	1,284	2,809	978	--	31,270	1,563
1876	-	25,645	990	7,064	1,508	2,173	807	--	39,197	1,960
1877	-	29,366	1,174	6,378	1,608	2,333	328	3	40,008	2,000
1878	-	27,660	1,195	4,273	1,224	2,713	357	--	36,227	1,811
1879	-	16,564	1,655	5,762	1,898	1,040	348	238*	24,850	1,242
1880	-	17,457	1,293	9,669	2,028	742	526	110*	31,825	1,591
1881	-	23,905	1,819	10,633	1,890	638	573	--	39,458	1,973
1882	-	24,968	1,412	4,720	2,186	1,791	219	—†	33,296	1,664
1883	-	34,506	2,278	9,083	2,271	2,418	399	--	50,935	2,547
1884	-	27,219	1,792	5,979	1,600	1,753	957	--	39,300	1,965

* Canadian. † About 40 tons of frozen salmon from Canada.

The above reports may be illustrated by the following table, showing the quantity of salmon reported or estimated to have been taken in those districts from which returns of this nature have been made for the two years 1883 and 1884.

COMPARATIVE RETURN OF SALMON CAUGHT IN NINETEEN FISHERY DISTRICTS IN ENGLAND AND WALES IN 1883 AND 1884.

District.	1883.						1884.					
	Salmon.			Migratory Trout.			Salmon.			Migratory Trout.		
	No.	Lbs.	Total.	No.	Lbs.	Total.	No.	Lbs.	Total.	No.	Lbs.	Total.
West Cumberland	1,060	8,359	5,573	4,513	5,358	13,717	617	5,126	9,039	2,469	3,913	3,086
Ribble	5,147	61,764	5,147	—	—	61,764	4,054	48,648	48,648	—	—	4,054
Clwyd and Elwy	3,000	11,900	3,700	700*	700*	12,600	2,400	9,550	9,800	250	250	2,650
Conway	224*	2,139*	224*	—	—	2,139*	118*	1,186*	1,186*	—	—	118
Seiont	1,489	12,094	1,963	474*	474*	12,568	1,429	10,598	10,907	309	309	1,738
Cleddy	—	—	80*	—	—	—	250*	—	—	—	—	250*
Towy	—	—	10,062**	—	—	120,750	—	—	117,750	—	—	9,730**
Usk	2,050*	20,800*	2,050*	—	—	20,800*	825*	6,516*	6,516*	—	—	825*
Severn	30,000	389,760	30,000	—	—	389,760	20,000	265,000	265,000	—	—	20,000
Avon, Brue, and Parret.	734	11,010	734	—	—	11,010	600	7,800	7,800	—	—	600
Avon and Erme	163	1,338	1,865	1,702	—	—	116†	—	—	1,064†	—	1,180†
Teign||	20*	160*	720*	700*	600*	760*	20*	160*	610*	300*	450*	320*
Exe	300*	2,100*	300*	—	—	2,100*	265*	2,200*	2,200*	—	—	265*
Axe	—	—	392**	—	—	4,700	—	—	3,270	—	—	273**
Avon and Stour	1,885§	—	1,885§	—	—	—	1,515	—	1,515	—	—	1,515
Trent	1,050	12,600	1,050	—	—	12,600	3,150	32,400	32,400	—	—	3,150
Yorkshire	6,745	79,647	7,380	635†	2,723†	76,370	3,237	33,145	41,646	794	3,501	4,031
Esk (Yorkshire)	4,811	—	4,811	—	—	—	5,940	—	5,940	—	—	5,940
Tyne	32,566	390,792	51,453	18,887	56,661	447,453	21,286	298,004	337,424	13,140	39,420	34,426

* By rod only.

† By net only.

‡ In the Teign, in addition to the above take by rods, 1,000 salmon weighing 7,000 lbs. were taken by net in 1884.

§ Not including the take in the Royalty fishery.

|| In the Tyne, these numbers are estimated from the Conservators' return of gross weight by averaging each fish at 12 lbs.

¶ Not including take by nets in the Avon.

The general result of this table is that, in the 19 districts from which anything like a return or an estimate of the numbers of salmon taken is forthcoming for the two years, the total yield was about 95,000 fish in 1884, compared with 130,000 fish in 1883. But this total is manifestly incomplete. It includes only the rod take in the Conway, Cloddy, Usk, Teign, and Exe districts, and only a portion of the take by nets in the Avon and Erme, and with two exceptions,—viz., the Seiont and the Teign, the produce of which appears in the table to have been smaller in 1884 than in 1883, whereas it was actually larger,—it includes none of the districts in which the take of salmon in 1884 is expressly stated to have been larger than, or at least as large as, in 1883. Indeed the table is of value only as a means of comparison—and that a very imperfect one—between a few rivers. Its chief value may be said to consist in the proof it affords of the difficulty of obtaining accurate information as to the produce of the salmon fisheries. This difficulty is exemplified very strongly in the returns from the Seiont district. It will be observed that the figures above given do not bear out the general report as to the increase or diminution in the take of salmon in that district in 1884. The clerk's report states that the general result of the fishing season was an "increased" take, but the detailed figures show a decrease of 225 fish, weighing 1,661 lbs. This discrepancy is no doubt explained by the fact that the fishermen are most unwilling to give any returns of the quantity of fish captured by them, fearing that, in the event of a profitable season, the rate of licence duty which they have to pay will be increased; hence, although it was generally admitted that the season of 1884 was better than that of 1883, only a few of the fishermen made any return—and that an imperfect return—of their actual catch. If the fishermen could be made to understand and believe that this and other information which they are asked to supply is required for the purpose of enabling better steps to be taken for increasing the productiveness of the fisheries, and not with the object of taxing them, one of the first obstacles to a more thorough mastery of the difficult and complex problem we have to solve would be overcome.

The returns of the Boards of Conservators (*see* Appendix, Fish-passes, p. 51) show what steps have been taken in the various districts for facilitating the passage of salmon over weirs. These returns it may be desirable to supplement with the following details:—

The pass at Branthwaite Weir, on the Derwent, built on a plan suggested by Mr. Fryer, having been reported by the Board of Conservators as well constructed and efficient, has received the formal approval of the Secretary of State since the date of the Board's report. The Committee appointed by the Board to report upon it state that "since the erection of the pass few fish "rest in the pools below the weir," and they go on to say that, although, when they inspected it, the weir itself was nearly dry, "there was sufficient water flowing over the pass to enable fish of "considerable size to ascend." From the inquiries they made on

the spot they are able to report that fish were "frequently seen ascending the pass during last year." This is all the more satisfactory considering the extreme lowness of the water; and it only remains for me to add, for the information of those who fear that the construction of an efficient pass necessarily entails any interference with the supply of water to the mill, that the level of the sill of the weir has not been in any way interfered with.

One of the weirs in the Clwyd and Elwy district, and known as the Pontnewydd Weir, to which a pass has been attached during the past year, affords another instance of the fact that the milling and fishery interests are not necessarily inimical, but that, on the other hand, they may often be easily harmonized. In the course of an inspection of the weirs on the Elwy, Mr. Fryer reports that his attention was directed to this weir, which he describes as "an upright weir, 6 feet in height," which, when he saw it, was in "a dangerous state, being partly undermined by the floods and threatening to collapse unless immediate measures were taken to render it secure. Mr. O. J. Williams, the agent to the owner of the weir, was at that time taking measurements with a view to undertaking the repair of the weir, and appealed to me for advice. I explained to him," Mr. Fryer continues, "that, under the circumstances, I had not anything to do or say anything officially in the matter, but that if I might make a suggestion in my individual and private capacity I should propose that a couple of concrete buttresses be built near the centre of the weir on the lower side, with a space of about 10 feet in the clear between them; that those buttresses should be utilized as the side walls of a pass, which should be constructed by subdividing the intervening space into a series of pools, on the same principle as the pass at Addingham in Yorkshire. Being pressed to name someone who would be likely to do the work satisfactorily, I suggested that Mr. Williams might do worse than ask Mr. Watson, of the Addingham Mills, who constructed the pass at Addingham so successfully, and at such slight cost, to place his experience at his disposal." This Mr. Wynn did. Mr. Watson very kindly went down to North Wales, and the work has been carried out so successfully that, not only has the weir been saved from ruin, but, as the means to that end, a salmon pass has been constructed which the Board characterizes as "most successful."

A pass has been erected on the diagonal baulk plan at Nursling Mill Dam, on the Test, referred to in my last report. The pass is not built quite in accordance with the plans submitted to me and provisionally sanctioned, the baulk not being placed at a sufficiently acute angle with the line of the weir; but as the work has been carried out in a substantial manner, and as salmon have been seen to pass up it, I have hesitated to condemn the pass as ineffectual. No plans have yet been sent to me for the formal approval of the Secretary of State, and I am awaiting the result of certain observations upon the working of the pass in different states of the water before taking any further steps in the matter.

With regard to the steps taken in the past year in the erection of gratings under the Salmon Acts, only one case calls for special reference. In January 1883 Mr. Jebb, the engineer to the Shropshire Union Railways and Canal Company, wrote to me as follows :—" Sir,—Some 10 years ago I had a long correspondence with the then Inspectors of Salmon Fisheries and the Severn Board of Conservators as to the obstruction caused by the grating placed at the entrance to the canal feeder at Abertanat (Montgomeryshire). This feeder is also a mill race, and conveys water from the River Tanat to the Carreghofa Mill. There are several reasons why I should be very glad to have an interview with you on this subject. I intend being in London next week, and I should feel much obliged if you would give me an appointment." I accordingly fixed the 10th January for an interview. At the interview Mr. Jebb stated that he had received the following letter from Messrs. Burd and Sons, agents to the millowner :—

" SIR, Shrewsbury, November 18, 1882.
 " WE have had such serious complaints by the tenant, of injury to his working, by loss of water arising from the fish-grate placed near Carreghofa Hall, that we must remove it. We do not, however, like to take such a course without first calling your attention to the matter."

The result of this interview is shown in the following minute made on Mr. Jebb's letter at the time :—" Mr. Jebb called accordingly, and saw Mr. Huxley. It was arranged that, as it is desirable, before any alteration can be finally made, to arrange first with the owner of Carreghofa Mill, who objects to the grating, what sort of grating will best meet the case, and next with the Board, Mr. Jebb should make experiments with various gratings, and then apply to the Board and the Home Office for approval. As the existing grating does not appear to have been formally approved, there does not appear to be any reason why such experiments should not be made."

The section of the Act relating to the grating is as follows (section 13 of the Salmon Fishery Act, 1861) :—" Where salmon or the young of salmon are led aside out of the main stream by means of any artificial channel used for the purpose of supplying towns with water, or for supplying any navigable canal, the company or persons having the control over such artificial channel shall, within six months after the commencement of this Act, put up and shall maintain, at their own costs and charges, a grating or gratings across such channel, for the purpose of preventing the descent of the salmon or the young of salmon, and such grating or gratings shall be placed in such form and manner as may be approved by one of the inspectors in this Act mentioned." Certain penalties are then imposed for non-compliance with this section, which goes on :—" Provided always, that no such grating shall be so placed as to interfere with the passage of boats on any navigable canal." By section 4 of the Salmon Fishery Act, 1873, a "grating" is

defined to "mean and include any device approved by the Secretary of State for preventing the passage of fish through any channel."

From these provisions of the law it will be obvious that the question lay entirely between the Canal Company and the Secretary of State as advised by the Inspector; and that, although the Inspector would naturally give the Board information of what was going on—and, as the above minute shows, was desirous that the arrangement finally sanctioned should be such as the Board would approve—he was under no sort of legal or other obligation to consult the Board of Conservators.

On April 26th, 1884, Mr. Jebb wrote to me as follows:—

Dear Sir,

Some time ago I had an interview with you with reference to the grating which was placed some years ago at the entrance to the Canal Company's feeder at Abertanat. At that interview it was arranged that I should see the owner of the mill, who has a right to take water from the feeder, with the view of agreeing, if possible, upon some form of grating that should be at once close enough to prevent fish getting out of the river into the feeder and yet open enough to admit of the passage of sufficient water for both the mill and the canal. I now enclose a plan of a grating which I think (with careful watchfulness on the part of the man in charge of it) is likely to answer the above requirements. The agent of the millowner has expressed himself perfectly willing to give such a grating a fair trial. I beg now to ask your formal approval of the grating, on receipt of which I will have it put up; or, if you would prefer it, I will have this done without your formal approval, so that an opportunity may be afforded for yourself and the conservators of the River Severn to satisfy yourselves of its efficiency before approving it. I regret that there has been so much delay in writing to you, but it has been unavoidable.—I am, &c. (Signed) GEORGE R. JEBB.

To this letter I replied on 29th April 1884:—"I think it advisable that the grating should, as you suggest, be put up in order that its efficiency may be tested."

On July 12th Mr. Jebb wrote as follows:—"I have now had a grating made and fixed according to the plan I sent you with my letter of 26th April, and trust you will consider it satisfactory, and be able to give me the formal approval of the Home Office."

On July 15th I forwarded this plan to the chairman of the Severn Board of Conservators, saying that it had "been forwarded to me for approval by the engineer to the Shropshire Union Railways and Canal Company;" and adding, "I understand that the grating has been tested by Mr. Jebb, and that the agent of the millowner has expressed himself in favour of it. I have the honour to request that you will be so good as to favour me with the opinion of your Board upon it."

On July 16 the chairman replied:—"I have to acknowledge the receipt of your letter of the 15th instant, enclosing plan of proposed new fish grating at Abertanat. I will ascertain the views of this Board upon it, but I may point out that the present grating has horizontal bars, and in my opinion the substitution of perpendicular bars is open to very grave objection."

And on 5th August 1884 the chairman wrote to me further, as follows:—

Sir,

Referring to your letter of the 15th July last, enclosing plan of a grating at the entrance to the Shropshire Union Canal at Abertanat, and requesting me to send you the opinion of the Severn Fishery Board upon it, I have the honour to return the plan herewith, and to state that very grave objections exist to the proposed alteration of the existing grating. By the 13th section of the Salmon Fishery Act, 1861, under which the company are bound to maintain the grating, the object of the grating is to prevent young salmon finding their way into the canal. A grating with perpendicular bars would not do this nearly as effectually as a grating with horizontal bars as at present. The samlets would go or be carried through a much smaller grating if the bars are perpendicular, and as this will defeat the very object the Legislature had in view in compelling the company to maintain the grating, I trust you will decline to sanction the change. The grating with the horizontal bars has now been in existence for some years; it has answered its purpose fairly well, and some very strong case should be made out before a change is sanctioned. At present I am wholly ignorant of the reason for the change. I may add that I entertain very grave doubts if there is any power when once a grating has been approved and erected under the 13th section to approve another grating of an entirely different construction, but even if the power exists the objection to the proposed change will, I hope, lead you to refuse your sanction to it.—I have, &c. (Signed) J. W. WILLIS BUND, Chairman, Severn Fishery Board.

I then instructed Mr. Fryer to inspect the grating, and report upon the whole case, and on the 14th August he reported as follows :—

I have the honour to report to you that on the 11th instant I examined the grating which has been experimentally placed at the mouth of the canal feeder at Abertanat.

Before describing the present grating it may be useful to recapitulate the principal facts connected with the negotiations that have taken place in regard to the erection of a grating at the spot in question.

In 1869 Mr. Walpole found that the grating originally placed in accordance with the provisions of section 13 of the Salmon Fishery Act, 1861, which had never been approved under the terms of that section, was in an inefficient state, and he recommended the erection of a grating with horizontal iron bars 3 inches broad, $\frac{1}{2}$ inch thick, and $\frac{1}{8}$ inch apart, and placed at an angle of 45° to the flow of the stream. Such a grating was subsequently constructed and erected by the Shropshire Union Railways and Canal Company, but not only did the Canal Company complain that the navigation of the canal was interrupted by the interference with the in-flow of water occasioned by the grating, but the lessee of the mill at Carreghofa, which derived its water power from the water flowing down the canal feeder—the canal feeder having originally existed only as a mill-leaf—complained that the effective working of his mill was also impeded. It is doubtful if the Act of Parliament ever contemplated the case of a canal feeder being also used as a mill-leaf, or *vice versé*; at any rate, as you are aware, it provided different remedies for the danger to fish caused by artificial channels used for navigation purposes on the one hand and those used for milling purposes on the other; and the Inspectors and the Board of Conservators held that they were compelled under the Act to regard the channel in question as existing for canal purposes only.

It is doubtful, however, whether the grating suggested by Mr. Walpole, and actually erected in 1869, was ever formally approved. Even if it had been, the fact—assuming it to be a fact, which I have no reason to doubt—that the navigation of the canal was interfered with would appear to have brought the grating within the proviso of the 13th section, which enacts that “no such grating shall be so placed as to interfere with the passage of boats on any navigable canal.”

To obviate the difficulties caused by the construction of the grating erected in 1869, it was, after prolonged negotiation, agreed between the

Canal Company, the Board of Conservators, and the Inspectors, that a grating of a different form, with wider* interspaces between the bars, and with upright bars, should be substituted for the other during such time of the year as there were no smolts in the river. This arrangement, though not ratified in a formal manner, has apparently been adhered to with more or less strictness,† although it does not appear to have quite satisfied the exigencies of the miller, if of the Canal Company; and last year the engineer to the Canal Company applied for permission to try some experiments, with a view to ascertaining what form of grating is best suited to meet the requirements of the case. The present grating is the result of these experiments. It consists of upright round iron bars $\frac{1}{2}$ -inch in diameter and 1 inch apart. Such a grating would not prevent the ingress of smolts, while it is fine enough to be pretty easily choked with leaves; and although, when I was there, not many leaves were falling, the lock-keeper employed by the company, who also has to keep the grating clear, said that he had some difficulty in preventing such an accumulation of leaves as to check the supply of water, at least for the purposes of the mill.

It is evident that considerable difficulty must be experienced in devising a form of grating adequate to the requirements of the case when the smolts are in the river. At such time, however, there are no leaves falling, and there is usually a fair supply of water, and the small grating required to keep out the smolts is not so likely to become choked with leaves and rubbish. At other times of the year, when smolts are with few exceptions absent, leaves are plentiful; but the wider bars required to give freer access to the water are sufficient to keep out the up-going fish. The arrangement, therefore, which allowed of two forms of grating to be used at different seasons of the year appears to be a reasonable one, and the question seems to be what is the smallest opening between the bars that will not cause an undue stoppage of water, and what is the best form which those bars should take.

Mr. Fryer went on to recommend that before attempting to decide the best form of grating an effort should be made to prevent the access of leaves and rubbish to the grating, and proposed that experiments should be made with a device which he suggested for the purpose, the details of which it is unnecessary to lengthen this report by quoting.

Before sanctioning these experiments I communicated Mr. Fryer's report to the chairman of the Board of Conservators, who replied as follows:—

Board of Conservators, Severn Fishery District, 3, Stone Buildings,
SIR, Lincoln's Inn, W.C., 20th August 1884.

I HAVE the honour to acknowledge the receipt of your letter of the 15th instant, enclosing Mr. Fryer's report upon the Abertanat grating, which I will lay before this Board at their next meeting. In the meantime, without in any way pledging myself to any of the matters or conclusions contained in that report, it seems to me desirable that the experiment therein suggested should be carried out at the cost of the

* Two inches apart.—T. H. H.

† The period from 14th February to 31st May was agreed upon as the "smolt season," during which the narrow grating was to be maintained; and so far as I am aware the Canal Company, from the time when this informal arrangement was made in 1874 to the time when I authorized a new form of grating in 1884, kept the fine grating in position not only during the "smolt season," as thus defined, but also at other periods of the year, as long as they could possibly do so without detriment to the supply of water to canal and mill. I am informed that the only occasions on which the grating was not strictly maintained during the smolt season were when it was removed by the miller without the knowledge of the Canal Company.—T. H. H.

Canal Company. I shall be glad to learn the result of the experiment, and trust that meanwhile the proposed new grating will not receive the sanction of the Home Office.*—I am, &c. (Signed) J. W. WILLIS BUND.

The Canal Company at once carried out the experiments in question, with the result that, except in times of flood, the grating was kept comparatively free from leaves. With the object of testing whether the grating might not be rendered still less liable to be choked by leaves, the company was next authorised to place the bars horizontally instead of vertically—an alteration which had this additional recommendation, that it was in conformity with the opinion of the chairman of the Board of Conservators, as expressed in his letter of August 5th, quoted above, in favour of horizontal bars.

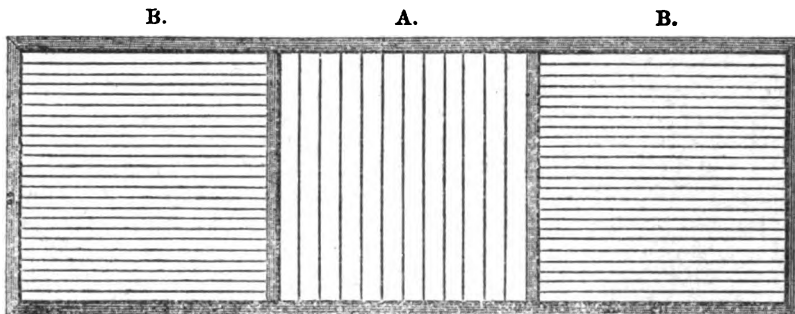
It is necessary to explain that the grating is constructed in three sections of equal width, inserted in an iron frame, from which the three sections can be separately removed; and in order to facilitate the alteration of the grating from perpendicular to horizontal, as well as to enable careful observations to be made as to the effect of the change, Mr. Jebb was authorised to remove one section at a time, and, pending its alteration, to temporarily replace it by a section of the old 2-inch grating. At the same time it was proposed, in order to ascertain exactly how far the grating so altered was effectual in keeping out the smolts, that “arrangements might be made with the Board of Conservators for a careful watch to be kept for the smolts, and for a second and finer grating or other contrivance to be placed in the leat itself, behind the existing grating,” so that if any smolts were then found to pass through the grating they could be “caught by a properly appointed officer of the Board and turned back into the river.” In the event of its being so proved that smolts did pass through the grating, Mr. Jebb undertook, if called upon to do so, to replace during the ensuing smolt season the narrow grating of 1869.

Of these proposals, which were communicated to them on the 24th November 1884, the Severn Board took no notice; but in February 1885 they took out a summons against the Canal Company for that they “did on the 3rd day of February 1885 fail to maintain across” the channel at Abertanat “for the purpose of preventing the descent of the young of salmon down the same, a proper and efficient grating contrary to the form of the statute in such case made and provided.”

On the hearing of the summons, it appeared in evidence that on the day in question the grating was in a state of transition; two sections of bars 1 inch apart had been altered from vertical to horizontal, and the third section, which had been removed for the purpose of a similar modification, was temporarily replaced by one

* It will be obvious from Mr. Fryer's report that the grating, though experimentally fixed, had only been sanctioned as an experiment.—T. H. H.

section of the former grating with upright bars 2 inches apart, as shown in the accompanying sketch :—



Section of new grating
with bars 1 inch apart.

Section of old grating with bars
2 inches apart temporarily
left in position.

Section of new grating
with bars 1 inch apart.

Had no alteration ever been sanctioned by me, all three sections of the grating would have consisted of upright bars 2 inches apart as at A, in accordance with the informal arrangement of 1874. The effect of the substitution of horizontal bars 1 inch apart, although only carried out in regard to two sections of the grating as at B B, was to increase the efficiency of the grating. The magistrates, however, held that "on the 3rd of February the grating was not sufficient to prevent the descent of young salmon, and they further said that there was no legal evidence before them that the grating had been approved by the Inspector," and convicted the Company, inflicting the full penalty of 1*l*.

From this it appears that the decision of the magistrates rests upon two grounds: (1.) That, in their judgment, the grating was inefficient; (2.) That there was no evidence that the grating had been approved by the Inspector.

(1.) With respect to the first point, I am advised that the Act of Parliament (Salmon Fishery Act, 1861, section 13, quoted at p. 9) recognises the Inspector as the only person who can decide—subject to the approval of the Secretary of State—whether a grating is efficient or not. In the present case, the grating being on its trial, the Inspector had of course given no final decision. The opinion expressed by the magistrates is therefore supererogatory, and, had they based their decision on this ground alone, I am informed that the Canal Company would have at once applied for a case on the point of law.

(2.) With respect to the second point, it is undoubted that there was no evidence that I had finally approved the grating, because, as a matter of fact, I had not finally approved it, and did not intend so to approve it, or any other, until I was satisfied of its efficiency. But there was no question that I had sanctioned every alteration which had been made in the form of the grating, although, following the course always hitherto adopted in such cases, I had, as a matter of administrative

convenience, abstained from giving a formal certificate of approval until a grating had been devised which I could satisfy myself would meet the requirements of the fishing, navigation, and milling interests concerned. To have furnished Mr. Jebb with a formal certificate of approval to meet every transitional stage through which the grating had necessarily to pass in the course of the experiments, which in the exercise of the duty imposed upon me by Act of Parliament I had felt it necessary to make, would have entailed needless formalities and occasioned unnecessary delay and trouble. Mr. Jebb, the engineer to the Canal Company, acted throughout in the most perfect good faith, submitting himself entirely to my authority in the matter, and displaying the greatest readiness to carry out, at considerable cost, all the experiments which were necessary in order to harmonize the conflicting interests concerned. All these facts were brought forward in evidence before the magistrates, who, however, convicted the Company, apparently holding the opinion that in the absence of a formal certificate from the Inspector they had no alternative. Under these circumstances I felt it my duty to protect the Canal Company from further proceedings by furnishing them with a formal certificate of my approval, "until further order," of the grating with horizontal bars 1 inch apart, which by that time had been completed in all three sections.*

Apart from considerations of legal technicality, however, the course of action adopted by the Severn Board affords ground for serious reflection.

It is obvious to any one conversant with salmon fishery legislation that the enforcement of the Salmon Acts, in a country like England, must depend upon the extent to which the working of them is found to be compatible with the interests of navigation and commerce; and that, as soon as these interests clash with those of the salmon fisheries, they must receive at least equal consideration. In cases where the two sets of interests conflict, I hold it to be my special duty to devise some arrangement by which the views of both parties may be reconciled; indeed, in this case, the obligation to consult the interests of navigation was specially imposed upon me by the provisions of the 13th section

* The grating consequently now consists, in all three sections, of horizontal bars 1 inch apart, as at B. As regards the efficiency of this grating, I have been furnished, since this report was in type, with the following copy of a report by the Inspector of the Shropshire Union Railways and Canal Company upon the subject:—

DEAR SIR,

Welshpool, 15th May 1885.

IN accordance with instructions conveyed in your letters of April 23rd and May 9th, I have made a careful examination of the River Tanat and the canal feeder near Abertanat on two occasions recently, viz., on April 28th and again on May 15th. Each time I have seen smolts in the river a short distance above the point of the weir, but I did not notice any between the baulk which we put across and the grating.

I have failed, however, to find a fish of any kind in the feeder, and, had there have been any, I feel confident I should have seen them, as the water was quite clear and scarce a ripple on the surface.

I am, &c.

George R. Jebb, Esq.

(Signed) CHARLES E. ROBINSON.

of the Act in question; and the only way of attaining that end was to make experiments with different forms of grating.

I cannot but think that, should the example of the Severn Board be generally imitated, and should important commercial companies be harassed with legal proceedings by Boards who are all the time aware that those companies are acting under the advice of the Inspector of Fisheries, and seek nothing but what is equitable, the safety of salmon legislation may before long be seriously imperilled.

So far as the Severn district is concerned, the only result of the action of the Severn Board will be that experiments on the best form of gratings will be made rather more tedious and troublesome than they were before.

The Salmon
Disease.

The reports of the various Boards on the progress of the salmon disease show that the fish have been affected with the *Saprolegnia ferax* to a much less degree than in recent years.

In the Eden 1,079 diseased salmon were taken by the water bailiffs and buried in 1884, and this the Board reports "is a considerable decrease from the two previous years."

In the Derwent there was "no increase in the disease since the previous year." The Clerk to the Board, reporting in December, 1884, adds that "a few weeks ago a heavy water took a great quantity of these diseased fish down to the sea." It is not stated whether these fish were dead or alive, or whether they had spawned. If they were spawned fish they were remarkably early for the Derwent.

In the West Cumberland district the disease re-appeared in July 1884, and from that time to the end of the year 73 diseased fish, or slightly fewer than in the previous year, were reported to the Board as having been taken out of the river.

In the Kent district the disease appeared to a slight extent in the spring months in both the Kent and Leven, but died out later on in the season, and in the autumn and up to the end of the year there was no evidence of its re-appearance.

In the Lune the disease was "not so bad as in the previous year in proportion to the quantity of fish in the rivers." In the Ribble the disease appeared only "very slightly." In the Dee, again, the disease was less virulent, and in the Clwyd and Elwy "only a few diseased fish" were seen. In the Conway, however, where the disease appeared later in the year than in 1883, the outbreak appears to have been exceptionally severe, and when the Board's report was sent in on the 5th January last the disease was stated to be "very bad," and to have been so for some time. With the exception of the Seiont, where "only a very few cases" were observed, no cases of disease appear to have occurred last year in any part of Wales between the Conway on the North and the Towy in South Wales, and there it was not very severe. In the Towy "there was very little disease, and it had entirely disappeared by the middle of March"; and again in the Usk, where it had been so destructive in the two previous years, and especially

in 1883, the disease disappeared in a great measure about the third week of January 1884. Many fish that had recovered from it were observed. There was a later outbreak in Monmouthshire towards the end of April, but it became entirely extinct by the end of May. In Breconshire very few cases were observed after April. In a very few cases it re-appeared about October, but according to the report of the Board, dated February 21st last, the number of fish which died from its effects during the past winter was extremely small. In the fresh waters of the Wye, disease appeared in the early months of 1884, but not to the same extent as in 1883. It however disappeared after the first floods in May and June.

According to the "18th Annual Report of the Board of Conservators of the Severn Fishery District," the salmon disease made its appearance in the spring in the Verniew, though not in a severe form. No diseased fish were found dead. One or two fish infected with the disease were also caught near Worcester. After May, however, the disease completely disappeared.

With the exception of a doubtful instance in the Axe, where a quantity of dead fish were seen floating about—the destruction of which, however, may have been due to other causes—no case of the epidemic occurred in any river between the Bristol Channel and Christchurch Bay. In January of this year, however, 23 dead salmon "having the fungus disease" were taken from the Hampshire Stour. From this point to the Humber, again, no disease was observed.* In the Yorkshire rivers "slight indications" of it were said to have been noticed, but the Conservators of the Yorkshire district state that they have no trustworthy information on the point. In the Yorkshire Esk it prevailed "to a very trifling extent."

Finally, the chairman of the Tyne states: "I observed several cases of salmon disease, and several were reported to me after the dry weather set in (March 16). I am inclined to think all the 'spring run' of fish died after the 6th April, and few or no fish came up the river above tide-way for any distance till October. No disease was seen in late run fish."

The general result of these reports is that there is a sensible diminution both in the virulence of the epidemic and in the area affected by it. It is noteworthy that this satisfactory change has occurred during the hottest and driest year since the disease first attracted serious attention. At that time, the idea was entertained that the outbreak was attributable to the exceptional scarcity of water in the rivers; but neither in 1878 nor in 1879, when attention was first drawn to the spread of the fungus in the

* Since this report has been in type I have been informed by the clerk to the Trent Fishery District, writing on May 11th, 1885, that "there has never been so much disease in the district before, and for the first time it is noticed that young fish one to two years old are affected. It was generally thought that only spawning fish were affected, but now all are alike." At the same time the clerk sent me, for examination, a small dace, which I found to be affected with *Saprolegnia ferax*, and he spoke of a pike of about 5 lbs. weight having been found "covered with disease" over one-third of it."

Nith, Annan, and Tweed, was the drought so severe as in 1884. The report of the Usk Conservators draws attention to this feature. "It is remarkable," they say, "that throughout the summer (of 1884), although the water was sluggish and impure, and the salmon in the lower waters were crowded together in the pools, no disease whatever was observed either among salmon or trout." It is evident that we have not yet arrived at a satisfactory explanation of the conditions which favour or arrest the growth of fungus on fish.

Mr. G. Murray is continuing the experiments with *Saprolegnia*, to which I have referred in previous reports, and has provided me with the following observations, which have a particular interest from their bearing upon the way in which the fungus may be diffused and communicated, and upon the manner in which it may be extirpated by competing organisms. Mr. Murray writes (20th April 1885):—

"During the latter part of spring and the early summer of last year a considerable number of the fish inhabiting the tanks in the Fish Culture Museum suffered from the attacks of *Saprolegnia*. The young salmon which had been hatched in the Fisheries Exhibition, and reared in the Fish Culture Museum, suffered most, and nearly all of those attacked die. This outbreak was entirely unexpected, and considering the circumstances under which it took place, its origin was at first inexplicable. The water in which the fish in question were living came from the same source as that which had a great number of times undergone the test of immersing flies in it without these showing a sign of the growth of *Saprolegnia*. I applied this test again to water taken before it entered the tanks, and the supply remained as pure as before; while, as would be expected, water from the tanks themselves yielded *Saprolegnia* readily. It was thus made certain that the disease was not conveyed to the fish through the water supply, and the next direction inquiry took was to ascertain if by any means the disease had been communicated to these fish from those in adjoining tanks, which were the subject of inoculation experiment. Careful inquiry brought no result. The experiments were being conducted in an isolated manner, and the landing nets, &c. used in the capture and handling of diseased fish had never been employed in other tanks. In my difficulties, Professor Huxley, foreseeing that the result of such an inquiry could not fail to be instructive, encouraged me to prosecute it, and suggested that the food given to the fish might be the vehicle of the infectious material. A consideration of this enabled us to pitch upon the earthworms used for this purpose as most likely to yield result. Several of these were intercepted while being conveyed to the tanks for food, and were placed under cultivation. After the lapse of two days, the *Saprolegnia* unmistakably showed itself, and, though comparison satisfied me of the identity of this fungus with that of the disease, the matter was put to absolute proof by using this fungus as the agent of

“ inoculation in the final successful experiment recorded last year.
“ Examination disclosed the presence (in two cases) of oospores
“ in the earthy contents of the worms, and these, I believe, were
“ the oospores of *Saprolegnia*. I never succeeded in finding any
“ worm at large on which the *Saprolegnia* was growing, and,
“ though the ground was damp, I was sufficiently surprised to
“ find alive even the resting state of this purely aquatic fungus,
“ since desiccation at an ordinary temperature soon kills it. The
“ fact that I ceased to find worms bearing *Saprolegnia* as the
“ summer advanced I attribute to the great dryness which
“ resulted from the exceptionally hot weather. The immediate
“ cause of the outbreak having been thus ascertained, the grave
“ question remained: Whence did the earthworms obtain the
“ *Saprolegnia*? I procured worms from various parts of the
“ country, including the neighbourhood of a river (the Tweed),
“ which contained diseased fish, and on none of these could
“ *Saprolegnia* be reared (without inoculation). I continued to
“ find it on earthworms—though not on all—procured from a
“ piece of waste ground adjoining the Fish Culture Museum,
“ and it soon became notable that worms only from a
“ certain region (a few yards in diameter) of this ground
“ yielded the fungus. It could never be found on those dug
“ up in the adjacent grounds of the Natural History Museum.
“ Now over the particular region indicated there were lying
“ a number of fish bones, which at once aroused curiosity.
“ The remarkable results obtained by M. Pasteur, in his
“ observations on earthworms as carriers of infectious material
“ suggested a clue to the way out of the difficulty, though I was
“ unwilling to believe, as I am now, that this aquatic fungus
“ could maintain life for any length of time in the ground. How-
“ ever, the discovery that the bones just mentioned belonged to
“ certain fish which had died in the tanks erected by the Fisheries
“ Exhibition Commissioners, and had been cast out there a few
“ months before, seemed to point in the direction which my
“ suspicions took. Mr. Edon (to whom I am much indebted for
“ assistance throughout this inquiry) informed me, however, that
“ to the best of his knowledge worms for food were never dug
“ up in that particular place, and its appearance bore out his
“ belief. Matters remained for some time in this unsatisfactory
“ position until, in going over the ground one day, I observed a
“ labourer digging in the very region which had been infected.
“ On questioning him, he succeeded in remembering having once
“ or twice in rainy weather earlier in the year obtained his worms
“ from there. (It was near shelter.) The agreement thus
“ established forces upon me the conclusion that the infectious
“ material was obtained from the dead fish cast out; that during
“ the damp weather it remained alive in its resting state, and
“ was spread abroad in the ground by earthworms; and that it
“ was finally conveyed by them into the tanks where the out-
“ break took place. Later in the year, as described, this source

“ of infection was dried up, while the outbreak was stopped by
 “ the precautions Mr. Edon took in his treatment of the fish.
 “ The following observations (confirmatory of those made by
 “ Pringsheim in 1851) of the power of movement in still water
 “ possessed by the zoospores of *Saprolegnia* may be of interest.
 “ Taking a large jar (Fig. 1, A), I plunged into it a tube (B) open
 “ at top and bottom to depths varying on separate occasions from
 “ three inches to nine. Having introduced into the tube thus placed
 “ a fly (S) bearing *Saprolegnia*, which floated on the surface of the
 “ water (and was prevented from sinking by means of a thread),
 “ other flies, F F F F (newly caught) were placed outside the
 “ tube on the surface of the water. The top of the tube was then
 “ plugged with cotton wool (C). In all cases the communication
 “ of the *Saprolegnia* to the flies outside the tube took place in the
 “ same time as is usually the case when the infected and fresh

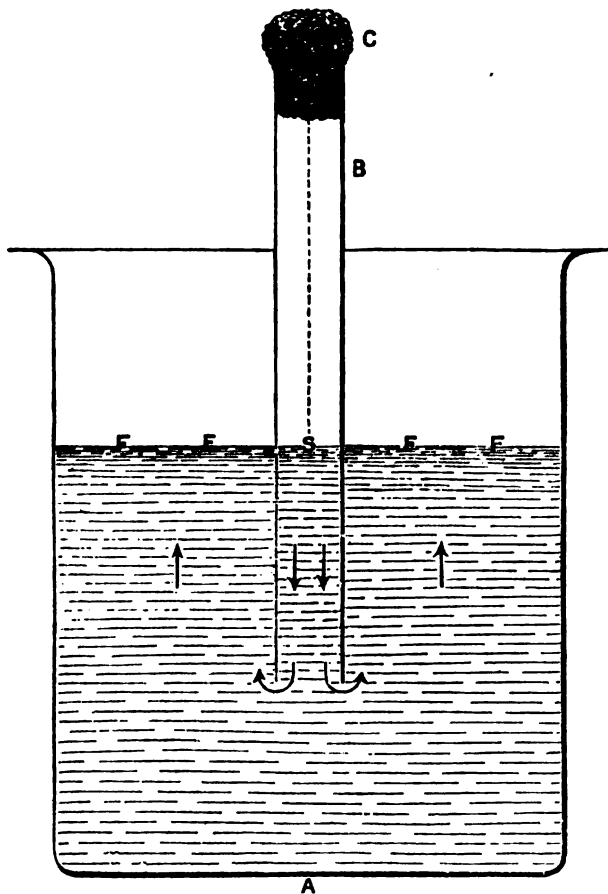


Fig. 1. Jar (A) and tube (B); C, plug of cotton wool; S, fly bearing *Saprolegnia*, F F F F, flies floating on the surface of the water, which were attacked by the locomotive spores thrown off from the *Saprolegnia* at S, and which must have taken the course indicated by the arrows in order to reach the flies F F.

"flies are placed in contact. [As would be expected, I have never been able to observe aerial communication in experiments with a tube closed at bottom and open at top, or with adjacent jars.]

"Towards the end of November a species of *Dictyuchus*, hitherto unknown to me, began to appear along with the *Saprolegnia* in the cultivations. It rapidly increased in power, and in the course of a few days obtained complete possession; and the *Saprolegnia* which had first been placed in cultivation three years before (all but a few days) by Professor Huxley, entirely disappeared. The suddenness and completeness with which it was driven from the field were highly impressive, as well as not a little annoying after a period of attention to it of so long duration. However, the circumstance had its significance in exhibiting the existence of a powerful competition with the *Saprolegnia*. Whence did it come? What influence does it exert at large on this disease of fishes in thus driving it from its stronghold in the bodies of insects, &c. in water? Especially what is its action on the skin of fishes?"

These observations by Mr. Murray appear to me to be of very great importance. The first shows that the *Saprolegnia* infection may be conveyed through the most unexpected channels; the last strikingly exemplifies a truth which I ventured to enunciate in my first observations on this subject:—

"The struggle for existence among fungi as elsewhere; and the question whether a salmon which enters water in which *Saprolegnia* is present shall be infected or not depends on the mutual adjustment of a vast variety of conflicting agencies."*

It has been my duty, in the course of the past year, to hold three public inquiries into the propriety or otherwise of extending the fishing season in three fishery districts, viz., the Derwent (Cumberland), the Taw and Torridge, and the Avon and Erme. My reports on these three cases are reprinted in the Appendix, p. 39. In addition to this, applications have been made for the extension of the fishing season in the two Cornish fishery districts, viz., the Fowey and the Camel, both of which are referred to in my report on the Avon and Erme, and I have consequently thought it desirable to enter in some detail in this report into the general question of "late" and "early" rivers, and the further question how far the general law of close time can be adapted to the varying conditions of different localities, in virtue of which the fish run up certain rivers early in the spring, and in others not till late in the autumn.

Alteration of annual close season.

The question of "early" and "late" rivers is perhaps the most "Early" and difficult of all the questions connected with the general problem "late" rivers. of the preservation of our salmon rivers.

While, for the purpose of administering the law with the greatest facility, it would be very desirable to adopt a uniform close season in all rivers, such uniformity would in many cases defeat

* Twenty-first Annual Report, 1881, p. 28.

the very object for which a close season is established : for either the close season must be so protracted as to cover the whole period during which it is undesirable that the fish should be destroyed in the earliest as well as the latest rivers—whereby many rivers would be closed for a considerable period during which the capture of salmon might advantageously be permitted—or else a shorter close season must be fixed which would allow fishing to take place in many other rivers at a time when it ought to be prohibited. The old laws of salmon fishing prior to 1861 gave the justices authority to fix the periods at which fishing should begin and end in each county, and, as a result, there were hardly two rivers which had the same close season allotted to them. The following list shows the earliest and latest dates on which the close time for salmon used to begin in the principal English and Welsh rivers under the old law:—

River.	Commencement of Close Time.
Trent - - - -	August 12.
Avon (Somerset) - - - -	"
Ribble - - - -	August 31.
Dee - - - -	September 1.
*Severn - - - -	September 7.
Tyne - - - -	September 10.
Test - - - -	September 12.
Avon (Hants) - - - -	"
Itchen - - - -	"
Tees - - - -	September 17.
Wear - - - -	"
Exe - - - -	September 20.
*Wye - - - -	"
Derwent (Cumberland) - - - -	September 25.
Eden - - - -	"
Esk - - - -	"
Ouse (Yorkshire) - - - -	"
Wharfe - - - -	"
Lune - - - -	September 29.
Clwyd and Elwy - - - -	October 1.
Coquet - - - -	October 10.
Kent, Leven, &c.- - - -	"
Usk - - - -	October 14.
Ayrton - - - -	October 15.
Taw and Torridge - - - -	October 20.
Mawddach - - - -	October 21.
Aln - - - -	"
Cledy - - - -	October 31.
Towy - - - -	November 1.
Teify - - - -	November 3.

* Different close seasons were fixed for the different counties through which these rivers flowed. In the above table I have given the average of these dates as the commencement of the close season.

	River.	Commencement of Close Time.
Plym	- - - - -	November 14.
Dart	- - - - -	"
Axe	- - - - -	November 20.
Conway	- - - - -	November 30.
Fowey	- - - - -	December 3.
Dovey	- - - - -	December 14.
Tamar	- - - - -	December 15.
Camel	- - - - -	December 24.
Avon (Devonshire)	- - - - -	January 15.

It must not be taken for granted that the dates so fixed were always adopted in the best interests of the rivers to which they applied, for it is notorious that, before the Salmon Act of 1861 came into operation, the close times were often appointed—and on many rivers no close time was appointed at all—less with a view to the ultimate good of the fisheries than to the immediate anxiety of the fishermen to catch as many fish as they possibly could, without regard to their condition. Fifty years ago fish with well-developed spawn, and even in the act of spawning, were caught, and were deemed to be of excellent quality, which would now be left in the water, not only for the sake of keeping up the future stock, but because they would be generally pronounced unfit to eat. Still, the foregoing list, if it does not represent accurately the relative “earliness” and “lateness” of the salmon in the different rivers, at least shows the popular feeling in regard to the dates to which it was considered advisable that fishing should be allowed to extend, and illustrates the difficulty of adopting a general close season acceptable to all.

The close time on the Devonshire Avon, the latest of all the rivers in the list, did not end till May 6th, so that, beginning with the Trent, the earliest river in the list, and ending with the Devonshire Avon, it was “close time for salmon” in one part or another of England or Wales from August 12th to May 6th, or for nearly nine months. It is obvious that, if these dates of opening and closing were justified by the natural condition of the different rivers, it would be undesirable to have a uniform close season extending over three-fourths of the year, with the result that fishing would be prohibited in every river at some period or other when it ought to be allowed. On the other hand, a shorter uniform close time involved the dilemma of having a fixed period which would leave many rivers unprotected at a time when they ought to be closed, or of having a different close time in every river or group of rivers, with the danger that fish illegally caught in the one would be sold as legally captured in another. When the Royal Commission of 1861 came to deal with the question, it recommended a uniform close season, and Parliament adopted that recommendation in passing the Act of 1861, which fixed the close time between September 1st and February 1st for all rivers, and prohibited the sale, during that period, of all but imported or cured

salmon. At the same time, Parliament gave the Home Office power to extend or vary this close season, but, as it gave no authority to alter the period during which the sale of salmon was prohibited, there was little or no object in making use of the power, except for the purpose of lengthening the close season.

In the course of a few years, however, it was found that the fixed uniform close season was not adapted to the habits of the fish in many rivers. Few if any of the rivers were found to be "early" enough to require the close season to commence *before* the 1st September, but in many cases not only the fishermen but the Conservators of many rivers expressed a strong desire that fishing should be allowed to continue till a later date. The Act of 1873 gave power to the Boards of Conservators to alter the close season provided that it did not commence later than the 1st November, and various concessions in this direction have been granted from time to time, as shown in the following list of those districts in which an alteration in the close season for nets has been approved by the Secretary of State :—

River.	Close Time begins.		
Avon and Stour	-	-	August 15.
Lune (lower waters)	-	-	September 8.
Eden (lower waters)	-	-	September 10.
Dovey	-	-	September 14.
Derwent (Cumberland)	-	-	September 15.
Ehen, Esk, Mite, Irt, and Calder	-	-	"
Kent, Leven, and Duddon	-	-	"
Clwyd and Elwy	-	-	"
Conway	-	-	"
Seiont	-	-	"
Dwyfach	-	-	"
Cleddy	-	-	"
Ogmore	-	-	"
Coquet	-	-	"
Axe	-	-	September 20.
Taw and Torridge	-	-	September 21.
Avon and Erme	-	-	"
Camel	-	-	October 1.
Fowey (lower waters)	-	-	"

Of the districts in the above list the four last, the Taw and Torridge, the Avon and Erme, the Camel, and the Fowey have all asked for an extension of the fishing season to November 1, the latest date on which the close time can be made to begin under the present law.

As I have already stated, these cases are discussed in my special reports, reprinted at p. 39 in the Appendix, and I do not propose to refer to them particularly here, beyond pointing out that the Fowey, the Camel, and the Devonshire Avon are among the five rivers in which, under the old dispensation, the close time began later than the 1st December; and the fact that these rivers have thus, under two sets of laws, proved themselves to be con-

spicuously "late" rivers, not to mention others which have done so in a less marked degree, calls for careful consideration in the interests, not only of these particular rivers themselves, but of all the other salmon rivers in the country.

It is a matter of common knowledge that the salmon is one of those fishes which migrate periodically from the sea to fresh waters, and back again from the fresh waters to the sea, and that there is a constant relation between the periods of marine and fresh water life and those in which the alimentary and reproductive functions of the fish are in full activity. The relation is such that sexual maturity is reached and the eggs of the salmon are deposited only during the period of freshwater life; while, after the young has passed through the parr and smolt stages, the fish takes food, almost exclusively, during its residence in the sea, and it grows and increases in weight only during this period.

From what is known of the history of land-locked salmon, it would appear that the connexion between the period of sea life and that of growth and nutrition is not to be sought in the physical or chemical characters of the waters of the ocean, but simply in the fact that, under ordinary circumstances, the sea alone supplies in sufficient abundance the kinds of food which suit the fish. And, although the contrary opinion has often been expressed, I am not aware that there is any reason for believing that the physical or chemical characters of the fresh water into which the salmon enters have anything to do with the development of the reproductive organs.

Among those bony fishes which constantly inhabit the same medium, that is, either fresh or salt water, it is a common occurrence that the periods of nutritive activity and of sexual activity alternate with one another. The herring of our shores, for example, never leaves the sea. But there is one period in the life of the fish (the so-called "*matie*" condition), during which the herring feeds voraciously, grows, and finally lays up a great stock of nutritive matter, while the reproductive organs remain rudimentary; and this is followed by another period during which the fish leaves off feeding, while the reproductive organs attain an enormous size at the expense of the nutritive matters previously stored up in the body; in this condition the herring is said to be "full." The milt, or roe, is then discharged, and the "shotten" herring, as it is then called, recommences to feed.

Fresh-run-salmon in spring are always in a condition analogous to that of the "*matie*" herring; in late autumn they resemble "full" herring; while "*kelts*" answer to "shotten" herring. And as the herring passes through these three states without any change of medium, there is, on the face of the matter, no ground for the assumption that the change of medium has anything to do with the taking on of the full state in the salmon; in fact, such evidence as we have tends rather to the conclusion that the change of medium has been determined by the assumption of the "full" condition. Thus in some parts of the Baltic, the waters of which are less salt than those of the open sea, the herring have acquired

the habit of depositing their eggs in fresh water; and, in our own waters, the shad (which is a close ally of the herring) migrates like the salmon, though it does not go so high up the rivers. There can be no doubt that the ancestors of the shad were originally marine fish, like the ordinary herring; only, like the Baltic herring, the shad has found an advantage in depositing its eggs in fresh water. And it is highly probable that the salmon is derived from a primitive salmonoid of purely marine habit, which long since learned to profit by a similar change of residence. If this is so, it is obvious that the conditions which determine the most advantageous time of migration from the sea to fresh water must be these: 1. It must take place late enough to allow of the formation of a store of nutriment sufficient for the development of the reproductive organs, and to cover the waste involved in the ordinary processes of life, during the residence of the fish in fresh water; and, 2. It must take place early enough to allow the fish to reach the most suitable breeding ground before the complete maturation of the roe or milt.

We may call the interval between the ascent of the earliest and that of the latest fish in any given river the "anadromous period" of the river. Now it will be obvious that the length of this anadromous period must depend upon a great variety of conditions with regard to the great majority of which we are in total ignorance.

It will depend, for example, on the abundance of appropriate food in the regions of the sea inhabited by the salmon; upon the distance from the sea to the breeding ground; upon the time at which the conditions of temperature in the breeding ground are most favourable; upon the seasons of the year at which freshes favourable for ascent occur.

Moreover, as the salmon is a fish of such size that (leaving man out of consideration) there are far more enemies competent to destroy it in the sea than in freshwater, it may be an advantage to the fish to enter a river at the earliest possible moment in a locality in which its marine enemies abound; while, where these enemies are scanty, it may be no less advantageous to take advantage of the supply of food in the sea to the latest possible moment.

All these considerations, and a good many more which will readily suggest themselves to those who think over the matter, with a due knowledge of the complex conditions of fish life, must be carefully borne in mind, when we attempt to base any conclusions upon the ascertained facts relating to the migration of salmon.

These facts are by no means so accurately determined as they should be, inasmuch as there are very few salmon rivers in England and Wales with respect to which full and exact records have been kept for any long period of years; but such information as has been accessible to me leads to the following conclusions:--

1. Taking all the English and Welsh rivers together, the period in which salmon, whether many or few, are to be found running

up in one or other of them covers not only the whole of the spring, summer, and autumn seasons, but at least two months (December and February) of the winter, while even January cannot be absolutely excluded. So that it may be said that there is no month in the year in which some one or other of these rivers does not contain ascending salmon.

But it is also true that the number of ascending fish varies very much, not only on account of the occurrence of freshes and droughts, but in respect of particular portions of the whole anadromous period. In sundry rivers there are two or more periods of "main run," when many fish ascend together; while, in the intervals of these runs, or before or after them, the ascending fish are few and far between. Sometimes these periods are far apart and represent distinct early spring and late summer, or early autumn, shoals (*e.g.* Eden). Sometimes they are massed together in the summer months (*e.g.* Severn); sometimes, finally, they are deferred to late autumn—October, November, or even December (*e.g.* Avon and Erme.)

I am not aware that there is any river in which an early main run (say in March) is not followed by another, or others, in summer or early autumn; but there appear to be several in which late main runs, say in October or November, are not preceded by early runs in the spring.

Thus there are rivers in which fish run up early, and also tolerably late; others, in which they ascend very late, and not early; others, in which the main runs occupy an intermediate position; and it does not seem practicable to separate these different classes of rivers by any sharply defined line of demarcation. The length of the "anadromous period," therefore, varies in the different rivers of England and Wales to an extraordinary extent. It may be as short as two or three months, and it may be as long as seven or eight months. And the difference between the dates of the commencement of this period in one river and in another may amount to six or seven months.

The fact that the length, and the commencement, of the anadromous period for salmon vary to this extent is now universally admitted, and is the foundation of the liberty given to Boards of Conservators by the Act of 1873 to defer the commencement of close time for nets from the 1st September to the 1st November in cases in which it could be shown that the main run of fish does not take place until after the 1st September. The propriety of granting this liberty has been much disputed. One of the main arguments employed against it has been based on the hypothesis that there are early and late breeding salmon, and that the fish which breed early ascend early, while those which breed late ascend late. A well-known authority says:—"It is observed " that some rivers are much earlier than others, the fish in them " coming into breeding condition and beginning to spawn at an " earlier period."*

* Yarrell. *British Fishes*, Vol. II. p. 7.

I am not aware of the grounds upon which Mr. Yarrell made this statement; and I am unable to discover any satisfactory evidence that it is well grounded. All the evidence to which I have access tends to show that, taking all the salmon rivers in England and Wales together, the spawning season covers more or less of November, the whole of December and January, and more or less of February. It is rare for fish to spawn as late as March, and I know of no conclusive evidence that they spawn earlier than November.* The maximum of spawning occurs in late November, December, and January. This conclusion is entirely in accordance with that arrived at by the Royal Commissioners in 1861 (Report, p. xxviii.):—"The great breeding season in England and Wales of all fish of the salmon kind is in the months of November, December, and January. We state this as a fact, and believe it will not vary more than a fortnight in any river; nay, more, that the same season extends to Scotland and Ireland, and that in reality it is nearly uniform throughout the United Kingdom. In some seasons it may commence a little earlier, or be continued a little later, but the principal breeding operations are performed chiefly in the three months mentioned."

But if the date of commencement, and the duration, of the spawning season are, within narrow limits, everywhere the same, what ground is there for the hypothesis that fish which ascend early will breed earlier than those which ascend late?

The Eden is a distinctly early northern river.† Fish ascend as early as January; the main runs occur in March and August; and the spawning season covers the months of November, December, and January. The Kent is a late northern river, as the main runs do not take place till August. Nevertheless, the spawning season is from the middle of November to the middle of January.

The Exe is an early southern river. The main runs occur in "spring and fall;" while December, January, and February constitute the spawning season. The Avon and Erme, on the other hand, are very late southern rivers, the main runs not taking place till October and November. Nevertheless, the spawning

* In the Tamar, peal are said to be ready to spawn in August, and salmon in September. In the Tavy the salmon are said to be ready to spawn in October, but the peal seldom spawn before November. I very much doubt, however, whether anyone ever saw a salmon or a peal actually spawning so early as August, September, or even October. The opinion that they are "ready to spawn" is inconclusive. Against this evidence may be cited the case of the neighbouring river, the Plym: I am informed by Mr. Henry Clark, one of the Conservators, that the fishermen fishing for herrings and coarse fish in the tidal waters of the Plym in December last caught at the same time spent peal just returned from spawning, and fresh run salmon going up to spawn; and that about the same time several salmon, weighing from 14 to 24 lbs., killed by otters, were picked up below the weir at Cann Quarry, "full of peas, nearly ripe," while in March last year some fresh-run peal going up, and spent salmon coming back, were caught together between the weir at Cann Quarry and the tidal waters.

† The dates here cited are given on the authority of the Nineteenth Annual Report, 1880.

season lies, as in the Exe, between December and the middle of February.

How are facts of this kind to be reconciled with the hypothesis that fish which ascend early spawn early and *vice versé*?

But if this assumption falls to the ground, the argument based upon it, that deferring the commencement of close time favours the late breeding fish at the expense of the early breeders, also disappears.

The fact is that the hypothesis, if it were true, would lead to a practical absurdity. For if the fish which enter a river early are those which breed early, the spring fish of an early river are those which ought to be protected, if we want to keep the river early. Consequently the annual close time in the estuaries of these rivers ought to include March, April, and May at least. Nevertheless, as everybody is aware, no such close time exists in the "early" rivers, and yet the early fish come up just as they always have done.

The argument which is under discussion appears to have had great weight with the Royal Commissioners of 1861. "By making," they reported, "the close time begin earlier, in fact by bringing it into accordance with the real breeding season, by thus enabling the fish that breed early to ascend early, the reproduction of their species and the return of the fish to the sea are correspondingly accelerated, the natural state of things is restored, and the river that had become late is made earlier."

It is obvious, however, that the Royal Commissioners ignore the true early fish altogether. They evidently entertain the conviction that the earliest among the autumn fish are those which breed first, and it is for the purpose of protecting these fish that they desire "to bring the close season into accordance with the true breeding season," which they have previously defined as November, December, and January.

In order to breed in these months they say (Report, p. xxviii.) "the great instinctive rush of the fish to their breeding waters takes place in September and the beginning of October; even in August some fish are getting heavy in spawn." It would be curious to know what the Commissioners thought about the fate of the fish which ascend earlier than September, and which in many rivers constitute the great bulk of the whole runs.

But without discussing this point any further it may be safely said that all experience since the passing of the Act of 1861 tends to show that, just as the capture of the early fish in early rivers has not tended in the least degree to make them late, so the preservation of the late fish in the very late rivers has not tended to make them later than they were.

I cannot say that I can discover any good ground for the belief that any kind of human interference is competent to affect the earliness or the lateness of a river. Differences in the habits of fish in the same river have been and are still observed where the artificial conditions are constant. For example, the existence of weirs and other obstructions in a river will naturally

retard the ascent of fish; and it has consequently been held that the presence of obstructions would account for one river being "late," and their absence for another river being "early." But this hypothesis does not account for the fact that some of the salmon will run up a certain river early in the year, and others late in the year, some with spawn undeveloped, others far advanced in spawn, without regard to the fact that there are no obstructions at all, or that the obstructions are constant all the year through. It is quite easy to understand that a river, the entrance to which was commanded by an impassable obstacle till late in the year, might be forcibly rendered "late" in the sense that the fish would be prevented from reaching it till the obstruction was removed or reduced, either by the occurrence of high autumn and winter floods, or by the operation of the law providing for a "free gap" or open passage for the fish during the annual close time. And it seems natural to imagine that, as the eggs in this case would be deposited "late" in the season, their fry would be correspondingly late in hatching out, and in descending to the sea; though this last is by no means a necessary consequence. But even if we assume that in course of time all the "early" fish would become extirpated, and only "late" fish would be allowed to ascend the river, and that by a process of evolution the fish would gradually accommodate themselves to circumstances and develop a "late" breed, it is not so easy to understand that the removal of the obstruction which had brought about such a change would have the effect of causing these "late" fish to become "early" fish.

On the occasion of my inquiry into the proposed alteration of the close season in the Cumberland Derwent, it was urged that the former practice of fishing the coops at Salmon Hall weir till the 10th October, and of practically closing the river to the great majority of the fish till after that date, had had the effect of converting the river into a "late" river; and that, if the river were thrown open earlier, the fish would by degrees take advantage of the opportunity of entering the river earlier, and so convert the river from a "late" into an "early" river. But the coops at Salmon Hall have been closed on the 1st September since the year 1861, and there is no evidence that during the quarter of a century which has elapsed since then the fish have become any earlier than they formerly were.

The adjoining rivers of West Cumberland, again, have always been practically free to the fish all the year round, and the fish in these rivers are, and apparently always have been, as late as they are in the Derwent.

If, in discussing the view that the earliness or lateness of a river may be affected by artificial conditions, I am obliged to come to the conclusion that it is devoid of foundation, I must not be supposed to disregard the importance of an adequate close time for salmon, or the desirability of according them a free run up and down the rivers throughout the year, or to deny the great advantages which have undoubtedly followed the adoption

of an early close season in so many rivers. I am not prepared for one moment to deny that, under the old regulations, fishing was carried on in many rivers far too late into the breeding season, and that in such rivers the stock of fish, which had been nearly exhausted by late fishing, has been replenished by the simple process of adopting an earlier close time, and preserving the breeding fish and the young fry; but there does not appear to me to be any evidence that any "early" river was formerly made "late" by late fishing, or that any "late" river has since been made "early" by the early cessation of fishing. The simple fact appears to me to have been that the "early" rivers were ruined by late fishing; but that the "late" rivers suffered to a much smaller extent. On the other hand, while the "early" rivers have derived enormous benefit from the adoption of a close season suited to their natural requirements, there is reason to believe that the fishermen and owners of fisheries in the "late" rivers, instead of sharing in the benefits which the early close season has conferred on the "early" rivers, have suffered disadvantage from the enforced closing of the "late" rivers at too early a period. This, at least, would have been the result in the case of many rivers if Parliament had not given the power conferred by the Act of 1873 to extend the fishing season within certain limits. As it is, there is evidence that the limit hitherto enforced has not met the requirements of the Cornish rivers and of the Avon and Erme. The fish in these rivers have had ample time to avail themselves of the opportunities which the Act has afforded them of getting up the rivers early in the season, but they have not done so, and the Cornish fishermen still call the Salmon Act an "Act to prevent the capture of salmon in the county of Cornwall."

I do not propose, at present, to enter into a discussion of the question how far the fact that the normal close season has begun in certain "early" districts should prevent a lengthened extension of the fishing season in a "late" district. The argument is that legal fishing late in the season in one district is likely to encourage illegal fishing in close time in another. This part of the question is briefly referred to in my report on the Avon and Erme district (*see* Appendix, p. 49).

If the "earliness" and "lateness" of different rivers cannot be attributed to the artificial causes that have been suggested, it remains to consider whether any light can be thrown upon the natural conditions which cause the local variations in the migration and spawning time of the salmon.

I have previously adverted to the extreme difficulty of this problem, and to the possibility that the conditions which determine early or late entrance into fresh water may have to be sought largely in the circumstances of the marine life of the salmon of which we know so little.

The problem, in fact, is not so much why some rivers are late, as why so many are early. The difficulty is to understand why a salmon should leave the sea months earlier than is necessary to give

it time to reach its breeding ground; not why it should stop in the sea until just time enough is left.

Hitherto, the reason for the observed differences between different rivers have been chiefly sought in the physical geography of river basins. For example:—

1. One reason has been looked for in the existence of a large lake at or near the head of a river.

In England, such a lake is found in the course of the following rivers:—

Eden: Ullswater and Haweswater.

Derwent: Bassenthwaite, Derwentwater, Crummock, Buttermere, Thirlmere, Loweswater.

Ehen: Ennerdale.

Irt: Wastwater.

Leven: Windermere and Coniston.

Dee: Bala.

While the Eden and the Dee may be classed among "early rivers," the other rivers in the list are rather "late" than "early." It may be held that the effect of Ullswater and Bala lakes on the Eden and Dee respectively is, owing to the length of the course of these rivers, much less marked than the effect of such great lakes as Windermere, Bassenthwaite, Derwentwater, and Ennerdale, on rivers so much shorter as the Leven, Derwent, and Ehen; but if this consideration is to have much weight, it would support the argument that rivers without any lakes at all would be much earlier than those with lakes. To disprove this assertion it is only necessary to point to the fact that extremes of earliness and lateness are found among the other rivers of the country possessing no lakes.

2. The existence or absence of a large estuary has also been suggested as the possible reason of the earliness or lateness of rivers. The following is a list of the principal estuaries which receive the waters of English and Welsh salmon rivers, from which it will be seen that rivers of very different degrees of "earliness" and "lateness" are similarly circumstanced in this respect:—

Solway: Eden.

Morecambe Bay: Leven, Kent, and Lune.

Estuary of the Dee: Dee.

Milford Haven: Cleddy.

Carmarthen Bay: Towy, Taff, Loughor.

Bristol Channel: Usk, Wye, Severn.

Bridgwater Bay: Brue and Parret.

Bideford Bay: Taw and Torridge.

Plymouth Sound: Tamar, Tavy, Plym.

Southampton Water: Test, Itchen.

Humber: Trent, Yorkshire rivers.

Here we have early rivers like the Eden, the Dee, the Lune, and the Test all falling into estuaries very similar in character to those which receive late rivers like the Kent, the Leven, the Taw, and the Torridge.

To the above list may be added the Rivers Mawddach, Dovey, Camel, Dart, Teign, Frome, and Tees, each falling into a considerable estuary, but having little in common in respect to the period at which the main run of salmon takes place.

The fact that the Severn, Wye, and Usk, which all fall into the same estuary, within a few miles of each other, have different "anadromous periods," is sufficient to disprove the theory that the existence of an estuary has anything to do with the period at which the great run of fish up-stream takes place. I have already alluded (page 3) to the curious contrast between the experience of the Usk and the Wye in the matter of the relative abundance of salmon in fresh and in salt waters during the season of 1884. The contrast which these same rivers afford in the matter of relative earliness and lateness is another illustration of the impossibility of accounting by rule of thumb for the movements of salmon and the fluctuations in their supply. Perhaps a still more striking instance of a marked dissimilarity, from a salmon fishery point of view, between rivers otherwise very similar in their general characteristics, may be found in the case of the three rivers flowing into Plymouth Sound, viz., the Tamar, the Tavy, and the Plym. Except that the Tamar is the much more voluminous stream of the two, the first two rivers are very similarly placed, falling alongside each other into separate inlets at the head of the estuary most remote from the sea, while the Plym, which is similar in point of size to the Tavy, discharges its water into a secondary arm of the Sound much nearer to the sea. As might be expected from this circumstance, salmon-peal or sea-trout enter the Plym somewhat earlier than the Tamar or the Tavy, running up the first-named river in twos and threes early in March, and increasing in number till the middle of June; while in the Tavy they do not begin running till early in May. These are followed in the Tavy first by the "school" peal running up early in June in shoals of from 15 to 30, and, second, by another run of peal about the middle of September or the beginning of October. In the Plym it is not till the middle of June that the "schoolers" are seen, and they cease running after the middle of August. In the Tamar peal are most plentiful in May and June, and few are seen in that river after July.

These dates do not hold good of the salmon, which begin to enter the Tamar as early as April, and the Tavy occasionally about the beginning of May, and continue running till October or November. In the Plym, on the other hand, no salmon are seen till the middle of October, and they continue running till the end of December.*

3. In the evidence on the "Natural History and Habits of Salmonoids in the Tweed and its Tributaries," which the Tweed Salmon Commissioners collected in 1867, it is stated by several witnesses that salmon do not enter the river freely when full of either ice or snow water, while, on the other hand, a high

* In 1884-5 they continued running till the middle of January.

temperature of the river water equally deters them from entering it. It is, indeed, reasonable to suppose that salmon are quite as sensitive as other animals to heat and cold, and that there is a limit of temperature above and below which the water is uncomfortable. In course of time, however, the development of the spawn forces them to go up-stream in search of suitable breeding places; but the fact that salmon will enter a river with the spawn in all stages of development seems to me to show that though their migration is primarily dependent upon the function of reproduction, other causes determine the commencement of the anadromous period, and of these causes it is possible that temperature may be one.

Broadly speaking, the rivers on the east coast of England are earlier than those on the western and southern coasts; and the rivers in the extreme south-west of England are the latest of all. The waters off the shores of Devon and Cornwall are much warmer than those of the German Ocean, and the fact that the salmon delay their entry into the rivers of the west much longer than into those of the east seems to show that they find the temperature of the seas in the West of England much more suitable than that of the colder North Sea, and that they are consequently not so anxious to seek the shelter of the estuaries. I say "of the estuaries," because after all the "earliness" or "lateness" of a river is judged by the fish taken in the nets at the mouth of a river quite as much as, if not more than, by the catch in actual fresh waters. It is true that there are very striking exceptions to this broad statement of the case. The Coquet is a much later river than any of its neighbours in the east, but this may be accounted for by the fact that that river is infested by bull-trout, whose habits are different from those of the true salmon, of which the Coquet contains hardly a specimen. Again, the Rivers Frome and Axe, in Dorsetshire, are later rivers than those immediately to the west as well as to the east of them. But, generally speaking, the nearer we approach the Land's End the later the rivers become.

Further explanation, however, must be sought for the differences which exist between the dates at which salmonoid fish of the same species enter different rivers, such, for example, as the difference between the Eden and the Lunc, which are early rivers, and the later rivers of West Cumberland, which lie between them; or between the Severn and its neighbours, the Wye and the Usk, which are both later than it. It has been suggested that this difference lies, to a large extent, in the nature of the country through which the rivers pass, and consequently in the variations in the average annual rainfall; in other words, in the temperature of the river water. Rivers rising in hilly country, and falling rapidly by a short course into the sea, are naturally colder than those which flow more slowly through a longer expanse of more level country, and which consequently have time to absorb a certain degree of warmth from the soil; and, on the supposition that salmon object to an excess of cold as much as to an excess of heat, it would follow that they would be tempted to enter the warmer

waters of the low country at a time when the waters of the hill rivers would be too cold for them. In other words, since the distribution of rainfall is dependent upon the level of the land, the rivers passing through districts with the heaviest rainfall would be late rivers, and those passing through low lands, where the rainfall is less, would be early rivers. Let us examine this theory by the light of the case of the Severn, Wye, and Usk. The Severn is 158 miles long, the Wye 135 miles, and the Usk 65 miles. The Severn and Wye both rise in Plynlimmon, and the Usk rises in the Eppynt Hills, 20 miles to the south. For only 40 miles of its course does the Severn flow through a country where the annual rainfall is more than 30 inches, and for nearly half of that distance the rainfall does not reach 40 inches. The whole of the rest of the course of the Severn is through the undulating counties of Salop, Worcester, and Gloucester, where the annual rainfall is only from 25 to 30 inches. The Wye, for rather less than the last half of its course, flows through a similar district, falling within the same rainfall area, but more than half of its course is through a district of much heavier rainfall. On the other hand, the course of the Usk falls for a very short distance, in its lower part, within the area of scanty rainfall, while at least one third of its course is through a district with a rainfall of from 50 to 75 inches, and more than a third through a district with a rainfall of from 30 to 50 inches.

According to the theory above set forth, the waters of the Severn would be much warmer than those of the Wye, and those of the Wye warmer than those of the Usk; and the salmon would be attracted into the Severn earlier in the season than into the Wye, and latest of the three into the Usk. This, in fact, is the order in which these three rivers would be placed in a list of early and late rivers.

The case of the Tamar, again, seems to bear out the theory suggested above. The run of salmon up the Tamar is much earlier than in the Plym; and we find that while the course of the Tamar is through a country whose rainfall ranges from 40 to 50 inches, the Plym and the Tavy rise in Dartmoor, where the rainfall exceeds 75 inches, and flow through a district—the Plym particularly—whose rainfall is heavier than that of the Tamar watershed. Of the three rivers the Tamar, as already pointed out, is the earliest, the Tavy comes next, and the Plym is the latest. The Avon and the Erme, equally late rivers, receive the same heavy rainfall as the Plym; and those late rivers, the Camel and the Fowey, again, both carry off a rainfall of as much as 75 inches; while the waters of the Dart and of the Taw, though originating like the Plym and the Tavy in Dartmoor, take a longer course before reaching the sea, and these rivers, though late, are consequently not so late as their neighbours. Applying this method of examination still further, we find the Exe, an earlier river than the Dart, draining a country whose rainfall averages from 30 to 40 inches only, and the Hampshire rivers, earlier still, flowing for part of their length through a district whose rainfall is as low as 25

inches. Although there is not a very great difference between the rainfall in the Exe and in the Avon and Stour districts, the course of these two last rivers is less steep than that of the Exe—Salisbury Plain being only about half the height of Exmoor above the sea level—and their waters have consequently a better opportunity of getting warmer before reaching the sea.

A few more instances may be quoted to test the relation between theory and fact. The Trent, an early river, is in its general characteristics very similar to the Severn. It is said to be earlier than the Severn, and if this is the case, it is in accordance with the fact that the average rainfall of its watershed, and particularly the rainfall of the lower part of the river, is less than that of the Severn basin. The rivers of Yorkshire, on the other side of the Humber, are later than the Trent, and we find that they rise in higher ground, and that the rainfall in their upper waters is considerably more than in the corresponding portions of the watershed of the Trent or the Severn. The Tyne and the Tees are fairly early rivers, the Tees being the earlier of the two, and these rivers hold about the same relation to each other in point of earliness as well as in point of steepness of slope and distribution of rainfall as the Usk and the Wye. The rivers of West Cumberland, lying between the Eden on the one hand and the Lune on the other, are much later than those rivers, and their rainfall and slope are greater. In these two respects the Cambrian rivers are very similar to the Cumbrian streams, and in point of lateness they also fall into the same category.

The applicability of this theory, however, though it has borne the test of examination so far, is not universal, especially if the investigation is carried into the sister kingdoms of Scotland and Ireland, and the inquiry must, as already pointed out, extend into several other fields of observation before we can hope to investigate in a satisfactory manner the causes of variations in the anadromous periods of different rivers. In the accompanying map, which shows the limits of the different fishery districts in England and Wales, an attempt is made to distinguish broadly between the relative earliness and lateness of the English salmon rivers. This map, however, is not put forth as an accurate representation of the state of the case. Indeed, it would appear that the ordinary use of the words "early" and "late," as applied to a salmon river, is not always based upon the same conception of their meaning. Some persons would characterise a river by the word "early" because a few stray salmon usually enter it very early in the season, say in February; others would judge by the circumstance that the last spawning fish did not run up till perhaps October or November, or even later, and would say the river was "late"; while others, again, referring to the fact of the first great run of fish taking place in, say June, would use a middle term, and say that the river was neither "early" nor "late," but "medium."

It is in the hope of stimulating exact observation as to the periods at which salmon appear: (1) off the coast, (2) in the estuary, and (3) in different parts of the fresh water, that I have

ventured to issue the map in question ; and I trust that Boards of Conservators, and others interested in the subject, will institute careful observations in respect of this and other points connected with the natural history of the *Salmonidæ*, about which our knowledge is still far less exact than it ought to be.

I have the honour to be,

Sir,

Your obedient servant,

THOMAS H. HUXLEY,

Inspector of Fisheries.

The Right Hon. the Secretary of State
for the Home Department.

APPENDICES.

APPENDICES.

APPENDIX I.

REPORT by the INSPECTOR of FISHERIES on an INQUIRY into a BYELAW altering the ANNUAL CLOSE SEASON for SALMON in the DERWENT (CUMBERLAND) FISHERY DISTRICT. .

SIR,

Home Office, July 10, 1884.

I HAVE the honour to inform you that, in accordance with your instructions, I held a public inquiry at the Court House, Cockermouth, on Tuesday, the 24th ultimo, into the following byelaw made by the Conservators of the Derwent (Cumberland) Fishery District :—

“The annual close season for all modes of salmon fishing (except with rod and line) shall commence on the 15th day of September, and terminate on the 10th day of March, both inclusive; and the annual close season for rods shall commence on the 15th day of November, and terminate on the 10th day of March, both inclusive.

“Heavy penalties are imposed under the Salmon Fishery Acts, 1861-1873, for the breach of any of the provisions relating to the annual close time as fixed by this byelaw.”

The effect of the above byelaw would be, (1) To lengthen the net season by 14 days, the commencement of the net close season, which at present begins on the 1st September, being deferred to the 15th of that month; and (2) to lengthen the rod season by nearly the same extent, the commencement of the rod close season, which at present begins on the 2nd November, being deferred to the 15th of that month. The close season for both nets and rods already ends on the 10th March.

In addition to the above byelaw, the Board of Conservators have passed a byelaw lengthening the weekly close season by six hours, extending it from six o'clock on Monday morning, as at present, to noon of that day.

The Board, therefore, propose to balance the favour shown to the net fisheries in the extension of the net fishing season by concessions which they consider equivalent to the rod fisheries; viz., by a similar extension of the rod-fishing season, and by an addition to the weekly close season for nets.

The inquiry was held in consequence of a memorial addressed to the Secretary of State objecting to the byelaw, signed by 13 members of the Board (eight of whom are riparian proprietors in the district), which was as follows :—

“The undersigned, who are members of the Board and proprietors in the upper portion of the district, consider that, in spite of the extra weekly close time, the fortnight's extension will most injuriously affect their interests, and also the object for which the Board was formed, and beg respectfully to urge you to refuse to confirm the byelaw. They base their objections to the proposed alteration on the following grounds :—

The only fishery on the river is one belonging to the Earl of Lonsdale, and is at Salmon Hall, about six miles from the mouth of the river. It consists of coops and net fishery. Whilst this fishery is at work but few salmon find their way higher up, except under the most favourable circumstances as regards

water in the weekly close time. The fish begin to run about the middle of June, so that the fishery had before two and a half months of fishing (namely from middle of June till September 1st), during which time the anglers above had small chance of catching any fish at all. Almost their only opportunity of getting good fresh-run fish was in the month of September, immediately after the nets and coops were taken off. Later on only heavy spawning fish come up, which are only for the most part fit for curing. We do not believe that the extension of the weekly close time will do us much good, as it is well known that salmon travel mainly during the night; and, at all events, the weekly extension would only amount to 60 hours in the two and a half months, as against a fortnight's loss of close time for the season. They are, therefore, of opinion that if the byelaw in question is confirmed, it would have a most unjust and injurious result, and there is the strongest feeling against it on the part of the anglers in the upper part of the district, who have to pay, from Ouse Bridge downwards, the same licence for rod-fishing as those below the fishery.

Mr. Walpole visited the river in 1880, when a similar extension was applied for, and advised against it. It is true that it was not then coupled with a proposal to extend the weekly close time, and that the latter is the result of a suggestion from Mr. Walpole, who thought it might be considered as some sort of set-off against the fortnight's extension. With all due deference to Mr. Walpole's opinion, we cannot agree with him, on account of the reasons stated above. Mr. Walpole truly remarks that the object of the Salmon Acts is to ensure protection for the fish by giving all parties an interest in their preservation. If the upper proprietors, on whom falls the burthen of protecting the breeding fish, are deprived to a great extent of the limited advantages they enjoyed before, the matter of preservation becomes to them personally almost immaterial. It was hoped also that a general idea of the importance of preserving the spawning fish was beginning to pervade the upper portion of the district, which, however, the confirmation of this byelaw would most undoubtedly discourage.

We may add that the byelaw was only carried by a majority of two out of a meeting of 19 members; and five members who were unable to be present wrote to the effect that they were opposed to the extension. Among the majority was the lessee of the fishery, who claimed (for the first time) the right to vote *ex officio*, though Lord Lonsdale and his agent are both on the Board, in respect of the fishery. Also another gentleman, who was appointed on the Board as agent to Mr. Marshall, who has fishing rights in the district, and who (the latter), nevertheless, came on this occasion to vote, as well as his agent, the agent himself having no property or interest in the district."

The meeting was largely attended. The Board was represented by Mr. Fletcher, the chairman, and Mr. Burn, the clerk of the Board. Mr. Webster appeared on behalf of the riparian proprietors of the upper waters; Mr. A. T. Morgan, on behalf of the Workington Angling Association; Mr. Lumb, on behalf of Lord Lonsdale, and the tenant of the Salmon Hall fishery, Mr. Dalzell; Mr. Newby, on behalf of Lord Leconfield. Numerous witnesses were called by these gentlemen, and, as the sitting lasted till past six o'clock, I may presume that I heard all that was to be said on both sides. I gathered from the evidence of the witnesses and the statements made by the representatives of the various interests affected that the case of the Board may be stated as follows:—

1. It was admitted on all sides that the Derwent is a late river, and that the bulk of the fish run up in September and October; and there was good evidence that, even in the latter month, a large proportion of the fish are in good condition. My predecessors have repeatedly recorded their belief in the lateness of the Derwent. Moreover, a memorial of a meeting of the anglers of the Derwent at Cockermouth on the 1st November 1883, signed by 180 persons, goes so far as to assert that the river Derwent is "the latest salmon river in the United Kingdom." This is confirmed by a return of the earliest period at

which salmon were taken at Salmon Hall for the last 10 years, furnished to me by Mr. Dalzell, which shows that no fish has been taken earlier than April 4th; that they rarely appear before the end of April or the beginning of May; and that sometimes they are as late as the end of May or the beginning of June.

2. The Derwent being thus a marked example of a "late" river, the Board consider that the principles which have guided the action of the Secretary of State in relation to the alteration of the close season in various rivers, since the Salmon Fishery Act, 1873, came into force, applied to it.

These principles are:—

- (a.) That no alteration in the close season for nets should, as a rule, be made without a corresponding alteration in the close season for rods and *vice versa*.
- (b.) That in the Cumberland rivers (excluding the Eden) the net-fishing season might be extended to the 14th September.

3. In 1880, when it was proposed to extend the open season for nets in the Derwent to the 14th September, Mr. Walpole expressed the opinion that the extension of the netting season might reasonably take place if the weekly close season were simultaneously extended to 48 hours as a set-off in favour of the rods; and the Board urge that by the proposed byelaws they not only adopt Mr. Walpole's recommendation, but give a further compensation to the rod fishers by extending the open season for rods to the 14th November, the byelaws proposed in 1880 not having contemplated any extension of the rod-fishing in the autumn.

4. The Board further state that their present action was taken in consequence of the memorial of the anglers already mentioned. This memorial points out that two out of the three fishery districts in the county of Cumberland have 14 days more open season for rods, although they are earlier rivers than the Derwent; and urges a similar extension of the rod season in the Derwent district. The Board was ready to comply with the wish of the rod fishermen, but felt bound, in accordance with the principles which have been acted upon hitherto by the Home Office, to grant a similar extension to the net fishermen; and they were the more ready to do this, as in the neighbouring fishery districts of the rivers Ehen, Esk, Irt, and Calder, and of the rivers Kent, Leven, and Duddon the net-fishing season continues to the 15th September; and, whatever reasons exist for granting the extension in those districts, those reasons apply, *a fortiori*, to the Derwent.

5. It further appears that within the last two or three years the facilities for netting the Derwent enjoyed by Lord Lonsdale's tenants have been seriously diminished by reason of the destruction of a weir which existed a short distance from Salmon Hall, and which created a large pool, known as the Yearle, in which considerable quantities of salmon were captured. The pool no longer exists, and the fishery is consequently much less productive.

6. Finally, it is urged that the cessation of net-fishing at the beginning of September deprives the public of a considerable supply of fish which the river would otherwise afford.

On the side of the opponents of the byelaw, the following points were urged:—

- 1. That "the byelaw was only carried by a majority of two, out of a meeting of 19 members; and five members who were unable to be present wrote to the effect that they were opposed to the extension. Among the majority was the lessee of the fishery, who claimed (for

" the first time) the right to vote *ex officio*, though Lord Lonsdale and his agent are both on the Board in respect of the fishery. Also another gentleman, who was appointed on the Board as agent to Mr. Marshall, who has fishing rights in the district, and who (the latter), nevertheless, came on this occasion to vote, as well as his agent." It appeared, however, that Lord Lonsdale and his agent, Mr. Robinson, are members of the Board appointed by Quarter Sessions. I asked if any objection was taken to the legality of the action of the other members of the Board in question, and, as none was raised, I do not see that the point has any relevance. I was further informed that, the total number of the conservators being 42, only 18 had pronounced themselves against the extension; and I could not discover that there was any particular reason why a larger number of conservators than 19 should not have attended the meeting at which the byelaw was passed.

2. It is contended that the increase of the weekly close time by six hours on Monday morning is of no benefit to the rod fishermen, because salmon run only at night. But elsewhere salmon certainly run by day as well as by night, and I could obtain nothing but hearsay evidence that it is otherwise in the Derwent.

3. It is alleged that at present few fish find their way up, except under favourable circumstances as regards water in the weekly close time, until after the 1st September, so that September is particularly valuable to the rod fishermen. I carefully examined Salmon Hall weir, and it does not appear to me that it can present a serious obstacle to the ascent of fish when the state of the river is such that the fish run. The relatively small number of fish which pass into the upper waters before September appears to be attributable chiefly to the lateness of the river.

I may remark, however, that at Salmon Hall the Low Coop Beck, which is practically a branch of the Derwent inclosing an island, is barred by a weir, the coop in which is disused in accordance with an order of the Special Commissioners for English Fisheries. This dam is not provided with a fish-pass, and the fish which ascend this branch of the stream must ordinarily be stopped at the foot of the dam in a position very favourable for illicit capture. It was asserted that fish do at present ascend by way of this beck; but this can hardly be the case, except in strong floods; and I think that the Board of Conservators and the proprietors generally on the river might take into serious consideration whether it would not be a greater advantage to the fisheries of the Derwent if this obstruction were provided with a pass, in accordance with the provisions either of sections 23 and 24 of the Salmon Fishery Act, 1861, as amended by section 53 of the Salmon Fishery Act, 1873, or of section 32 of the Salmon Fishery Act, 1865. Such a course would help to meet this ground of objection on the part of the upper proprietors to the extension of the netting season, while it would not interfere directly with the use of the Salmon Hall coop, and it would ultimately prove of great advantage to the river as a whole.

4. The opponents of the byelaw attribute the lateness of the Derwent to the long-continued existence of Salmon Hall weir as an obstacle to the ascent of fish earlier than September: before the present Salmon Act came into operation, indeed, the coops were kept fishing till the 10th October, in virtue of which it is contended that only late-breeding salmon were for a long period able to reach the upper waters; and it is suggested that the maintenance of the present close time will by degrees substitute an early breeding race of fish for the late-breeding race thus produced. I am unable, however, to see any justification for this speculation. In the first place, the adjacent rivers in the West

Cumberland district are well known to be late, though no such obstacle as Salmon Hall weir once was has existed in them. In the second place, the fish which ascend in the first fortnight of September cannot be said to be "early" fish, and there is no ground for supposing that their descendants will be early fish.

5. The further argument is urged against the byelaws that the number of fish reaching the upper waters, if the nets and coop at Salmon Hall work a fortnight longer than at present, will be so much diminished that the upper proprietors will not get enough to induce them to preserve the fish in their waters, and that the old state of feeling, which is dying away, will revive; and the anglers who memorialized the Board in favour of getting an addition of the days to the angling season were said not to desire this favour if it is to be accompanied by the proposed extension of the open season for nets. Considering the presence of a fish pass—of the nature of a free gap—in Salmon Hall weir, the injury to the net fishing done by the removal of Workington weir and the proposed increase of the weekly close time, I cannot think that the plea on the part of the upper proprietors that they will not get a fair share of fish if the extra fortnight's fishing is granted to the net and weir is well founded—especially as it is proposed simultaneously to extend the rod-fishing season. The memorial of the anglers, to which I have already referred, asserts that "a very heavy" run of salmon always appears in the Derwent after the present season"—i.e. the angling season—"has expired." That is to say, an abundance of fish in good condition ascend the river after the 2nd of November; and it seems to me that it can make no difference to the anglers who desire to fish for this "very heavy run of salmon" in November whether the nets are off the river on the 1st or the 15th September. On the other hand, if the present byelaw is disallowed, the access to these fish, which it is proposed to grant to the anglers as a compensation for the additional chance proposed to be given to the nets and weir, will be denied to them.

I should be very sorry to make any recommendation which might tend to diminish the efforts of the riparian proprietors of the upper waters to preserve the fish. But it appears to me that a due regard to the interests of the fish-consuming public in the first place, of the net and weir fishings in the second place, and of the anglers and upper proprietors in the third place, will be secured if the proposed byelaws are approved. Moreover, they are consistent with the policy which has always guided the action of the Secretary of State in dealing with proposals of this nature, and I submit that the byelaws should be confirmed accordingly.

I have, &c.

THOMAS H. HUXLEY,
Inspector of Fisheries.

The Under Secretary of State,
Home Office.

APPENDIX II.

REPORT by the INSPECTOR of FISHERIES on an INQUIRY into a BYELAW varying the CLOSE TIME for SALMON in the TAW and TORRIDGE FISHERY DISTRICT.

SIR,

Home Office, October 20, 1884.

I HAVE the honour to inform you that, in accordance with the instructions of the Secretary of State, I held an inquiry at the Bridge Hall, Barnstaple, on Tuesday, the 23rd of September, 1884, into the following byelaw made by the Conservators of the Taw and Torridge Fishery District:—

“That byelaw No. 1 be repealed, and in lieu thereof the following be substituted:—

“That the annual close season for all modes of salmon fishing (except with rod and line) shall commence on the 1st day of November, and terminate on the 30th day of April, both inclusive.

“The annual close season for rods shall commence on the 16th day of November, and terminate on the 31st day of March, both inclusive.

“Heavy penalties are imposed under the Salmon Fishery Acts, 1861-1873, for the breach of any of the provisions relating to the annual close season as fixed by this byelaw.”

Considerable difference of opinion appears to have prevailed in the Taw and Torridge Fishery District as to the close time best suited to those rivers. When the Salmon Fishery Act of 1873 came into force the Conservators made a byelaw, which was confirmed by the Secretary of State in the beginning of 1874, fixing the annual close season as follows:

For nets—from September 16 to April 30.

For rods—from November 16 to March 31.

At the end of the year, however, the Board passed a new byelaw, extending the netting season to September 30; but the byelaw was opposed by the upper proprietors, and the Board in consequence withdrew their application for its confirmation. In 1877, however, the Board made another byelaw, again extending the netting season to the end of September, and the Inspectors of Fisheries were therefore instructed to hold a public inquiry in the district into the matter. As a result of this inquiry, and as a compromise between the views of the net fishermen and of the upper proprietors, a byelaw was made and confirmed in 1878 fixing the close season—

For nets—from September 21 to April 30

For rods—from November 16 to March 31.

It will be seen that the new byelaw, which is the subject of this report, proposes to extend the netting season by a period of forty days in the autumn, but to make no alteration in the angling season.

This is not the first time that an application has been made to alter the close time as fixed by the byelaw of 1878. In 1882 the Board submitted a byelaw extending the netting season to the end of September, but this proposal was strongly objected to by the upper proprietors, on the ground that “the supply of summer fish in the upper waters had been “decreasing of late years,” and that “the proposed extension would “further diminish the supply of seasonable fish, and so be injurious to “the netting interests.” The byelaw was eventually disallowed, on technical ground, owing to an informality in the notices required by section 39 of the Salmon Fishery Act, 1873. In 1883 the Board again

submitted an identical byelaw for approval, and aroused the same opposition as before; and the byelaw was disallowed on the ground that it went beyond the general principles* which had guided the Home Office in dealing with applications for an alteration of the close season for salmon in England and Wales, and that no proof was afforded of the desirability of any departure from those principles.

Nevertheless, in the present year the Board submitted a new byelaw, extending the open season for nets, not to the end of September only, but to the end of October. Against this proposal various memorials were forwarded to this office by riparian owners, licensees, and others, setting forth that "this extension would be most disastrous to the interests of the nets, that it would destroy the chief supply of breeding fish, and reduce the river to the state in which it was 20 years ago. We cheerfully acknowledge," the memorials continued, "that the produce of the river both in early and late fish has largely increased within the last three years, and we attribute this chiefly to the present restrictions;" and any extension of the fishing season was strongly opposed.

One memorial, on the other hand, purporting to be signed by all the fishermen at Great Torrington and Beaford, while praying for permission for the angling season to commence about the middle of March, instead of at the end of the month, went on to say that "with regard to the nets, if a few days longer were given to them it would not injure the river in any way. All who have watched the ascent of salmon in our streams know that the great run does not commence till October."

The evidence given at the inquiry on this point was conflicting, but the balance of opinion seemed to be that, though an extension of the net fishing to the end of October as proposed by the byelaw would be most injurious to the river, a slight extension to the beginning or even to the middle of October would afford an addition to the supply of marketable fish without injuring the stock of breeding fish. There was a general concurrence of opinion that a great run of fish took place at the end of September or early in October; but opinions varied as to the proportion which the fish in marketable condition in that month bore to those too far advanced in spawn to be properly caught.

On this point three salmon, caught on the morning of the inquiry under the superintendence of the Board of Conservators, were tendered as witnesses.

The first of these fish, 36 inches in length, contained roe weighing 1 lb. The second, of the same length, contained roe weighing $2\frac{1}{2}$ lbs. The third, 28 inches in length, contained only 4 ozs. of roe. The flesh in each case was of good colour and in good condition, and the roe, even in the fish where it was most fully developed, was compact and firm. So far as I could find from these specimens, I should be inclined to agree with the witnesses who stated that a slight extension of the netting season might probably be advisable. The condition of the first and last of the three fish certainly supported this view. The condition of the second fish, on the other hand, as certainly showed that it would be highly impolitic to extend the fishing season to the end of October.

I am therefore unhesitatingly of opinion that the byelaw should be disallowed; and if, judging from the evidence laid before me, I had any doubt on the point, I should have no hesitation in deciding against the byelaw on the following grounds. It was stated in evidence that, at the meeting of the Conservators at which the byelaw was passed, only five members out of the 24 who constitute the Board voted for it and

* *Vide* 15th Annual Report of Inspectors, p. 34.

two against it; but that a special meeting was held in the week before my inquiry, at which it was resolved, by 11 to 2, "that the Board of Conservators recommend Professor Huxley to sanction the passing of no byelaw which made an alteration in the time of the close season." Lord Fortescue, the chairman of the Board, was not present at this meeting, but he stated in evidence before me that, had he been present, he would have voted for the above resolution. Under these circumstances, therefore, 12 votes would have been recorded in favour of this resolution, and, supposing the whole of the other 12 members of the Board had been present and voted against it, the resolution could, and no doubt would, have been carried by the chairman's casting vote. I have, therefore, having regard to all the conditions of the case, no alternative but to recommend the Secretary of State to disallow the byelaw.

I have, &c.

THOMAS H. HUXLEY,
Inspector of Fisheries.

The Under Secretary of State,
Home Office.

APPENDIX III.

REPORT by the INSPECTOR of FISHERIES on an INQUIRY into a BYELAW altering the ANNUAL CLOSE SEASON in the AVON and ERME FISHERY DISTRICT.

SIR,

Home Office, October 20, 1884.

I HAVE the honour to inform you that, in accordance with the instructions of the Secretary of State, I held a public inquiry at the King's Arms Hotel, Kingsbridge, on the 24th September 1884, into the following byelaw, made by the Conservators of the Avon and Erme Fishery District :—

" So much of Byelaw No. 1, made on the 30th day of September 1878, and confirmed on the 6th day of December 1878, as applies to the annual close season for all modes of salmon fishing except with rod and line is hereby repealed, and in lieu thereof it is enacted that :—

" The annual close season for all modes of salmon fishing, except with rod and line, shall commence on the 1st day of November, and terminate on the 4th day of April, both days inclusive."

" Heavy penalties are imposed under the Salmon Fishery Acts, 1861-1873, for the breach of any of the provisions relating to the annual close season as fixed by this byelaw."

The existing close season in the Avon and Erme Fishery District, as fixed by a byelaw made and confirmed in 1874, is—for nets, from 21st September to 31st March, both inclusive, while for rods the close season (which was fixed in that year between 21st November and 31st March) was altered in 1878, so as to be from 1st October to 31st January, both inclusive.

The proposed byelaw therefore leaves the angling season the same as before, while it extends the netting season by five weeks in the autumn.

The rivers Avon and Erme are admittedly late rivers, and the extension of the season from September 1st to September 21st, which was granted in 1874, has more than once been represented by the Conservators as insufficient to enable a fair proportion of the late run of fish to be captured.

The number of witnesses who appeared at the inquiry was not large, but they were unanimous in supporting the proposal of the Board. One of the principal witnesses was Mr. Ellis, the proprietor of a salmon box, or cruive, at Aveton Giffard, about 5 miles from the mouth of the river Avon, who is also a Conservator. Mr. Ellis stated that there are not 10 fish caught in the river before the end of June, and that the great run of salmon takes place in December and January; and this evidence was corroborated by one of the water bailiffs, who added that the fish spawn in January, February, and March.

This was in effect the whole evidence submitted to me, the remaining witnesses simply stating that they were, without exception, in favour of the byelaw being approved. On the other hand, although no objection to the byelaw was offered at the inquiry, two memorials in opposition were forwarded to the Home Office at the time when the alteration in the net close season was first proposed. These memorials were submitted in the interests of the rod fishermen, and alleged that the proposed extension of the fishing season, if granted, " would cause the destruction of most of the breeding fish." In support of this contention it was stated by one of the memorialists that the " fishery at Bantham, the main fishery on the river," is much less productive at

the present time than it was during the years 1846-9: in other words "that the salmon in this river (the Avon) were more plentiful in times "when they were not protected." This argument appears to me to answer itself, since the proposed extension of the fishing season is a relaxation of those protective regulations to the imposition of which, apparently, the alleged diminished yield of the river is attributed. I much regret that the memorialists were not represented at the inquiry, the more so as one of them, to whom special notice of the inquiry was sent, had previously expressed to me a desire to furnish some figures from old account books relating to the fishery at Bantham. Under the circumstances, however, I cannot do more than quote the official statement of the Board, which furnishes the grounds on which they base their application for the extension of the fishing season:—

"There are a few salmon taken at Bantham, the mouth of the river Avon, "before the present close season commences, but scarcely any are taken at "Aveton Gifford, the head of the tideway, unless there should be a flood, "although before the passing of the Act of 1861 a great number were taken "both at Aveton Gifford and Bantham in the autumn and the fish were in "good condition.

"The close season at that time did not commence before the 15th day of "January, and ended on the 6th day of May, and then there was always a "sufficient number of fish left for breeding purposes.

"But ever since the Act of 1861 came into operation the main harvest of "the fish pass up the river after the close season commences, and the greatest "part of them are killed by poachers, as soon as the water gets a little low; "while the legal fishermen have to be content with the gleanings of the "harvest.

"The river Avon literally swarms with salmon during the close season, "and in numberless cases the fish are known to disturb each other's spawning "beds.

"There is no doubt that, if only one half of the present number of fish was "allowed to ascend the upper waters in the autumn, they would produce more "young ones than are now produced by so many; and the other half might "be taken in a legal way, when in good condition, and be a benefit to the "public at large, for salmon really are in good condition in the Avon up to "the end of November, and it is very certain that our forefathers knew the "Avon was a very late river, otherwise they would not have fixed the com- "mencement of the close season on the 15th of January, as was the case "before 1861, as already stated."

In order to get some idea of the condition of the fish at the end of the period to which it was proposed to extend the fishing season, I last year asked the Conservators to have the river netted, and whatever fish were caught submitted to me for examination. On the 26th October last I accordingly received two fish which had been caught, I believe on the previous day, under the supervision of the Chairman and Clerk of the Board, at Mr. Ellis's trap at Aveton Gifford. These fish, one a male and the other a female, were in good condition, fresh run from the sea, and although the roe was considerably developed it would probably have been some time before they would be ready for spawning.

Although the evidence of only two fish is not, in itself, conclusive as to the condition of the rest of the stock of fish in the river, the above facts bear out the statements made before me at the inquiry, and I am inclined to think that the fishing season in the Avon and Erme might be extended.

But before acceding to a proposal which would extend the net-fishing season to the utmost limit allowed by the Act of Parliament,—however desirable such an extension may appear in the interest of the particular

river concerned,—it is necessary to consider how far other rivers may be affected.

The extension of the fishing season in any river also carries with it an extension of the period during which the salmon caught in that district may be sold in any part of England and Wales; hence the temptation is increased to catch fish in a neighbouring district, where the close season has already commenced, and sell them as fish legally caught in the district where the fishing season has been extended. Fortunately the greater vigilance exercised of late years by the officers of the various Boards of Conservators, and the officials of the great markets, has diminished this risk; but the risk has always to be reckoned with; and it is urged, as a reason for refusing the extension of the fishing season in the Avon and Erme, that the neighbouring rivers, which close earlier, are in danger of an increase of poaching. At the time the application was made for the approval of the byelaw which is the subject of this report, similar applications were made before me from the Taw and Torridge and the Camel Fishery Districts; at the same time the desire of the Fowey District for an extension of the fishing season was notorious; and the wish was expressed, in some quarters at least, for an extension of the fishing season in the Tamar and Plym. Under these circumstances, and with the approval of the Secretary of State, I suggested that the Conservators of these various districts should meet and endeavour to agree upon some common course of action in applying for such alteration of their respective close seasons as might be found desirable, and as nearly as possible for uniform periods. A group of districts with uniform close seasons would not present the same difficulties and anomalies as a series of districts with different close seasons, and, if common action of this kind could be taken, the objections which exist to a lengthened extension of the fishing season in a single district would be to a large extent removed. Unfortunately at the conference which was held at Plymouth, in accordance with the above suggestion, and attended by representatives of the various Boards referred to, no definite decision was arrived at. The case of the Taw and Torridge has been dealt with in a separate report, and the Tamar and Plym Board has not intimated its intention to act in the matter. But I have reason to believe that the Camel Board will press its application for an extension of the fishing season to the end of October, and that the Fowey Conservators will also apply for the approval of a byelaw extending the open season to the 1st November in default of that much longer extension for which, it is generally admitted, the Fowey has made out a strong case, but which the law in its present state does not allow. Under these circumstances, I submit that the byelaw made by the Conservators of the Avon and Erme District should for the present be neither confirmed nor disallowed. The byelaw could not conveniently come into force this year, and before the next fishing season has expired an opportunity will be afforded to the neighbouring districts of taking such action in the matter as they may deem desirable.

I have, &c.

THOMAS H. HUXLEY,
Inspector of Fisheries.

The Under Secretary of State,
Home Office

APPENDIX IV.

QUESTIONS FORWARDED BY THE INSPECTOR
OF FISHERIES TO THE VARIOUS BOARDS OF
CONSERVATORS.

1.—Has the take of salmon and migratory trout in your district in 1884 increased or diminished: (a.) In tidal waters. (b.) In fresh waters. (c.) Generally throughout the district?

2.—Can you give any idea of the number of salmon and migratory trout caught in your district in 1884: (a.) With net. (b.) With rod?

3.—Has the number of non-migratory trout increased in your district since the Fresh Water Fisheries Act came into operation? Can you give any idea of the number of non-migratory trout taken in your district in 1884?

4.—Did "salmon disease" appear in your district in 1884? If so, state full particulars.

5.—Have any new weirs been built, or old weirs rebuilt or altered in your district in 1884? If so, specify them.

6.—Have any new passes been built in 1884, or old passes altered? Have such new passes or alterations proved successful?

7.—Have any new mines or factories using substances deleterious to fish been opened in your district in 1884; or has any new substance poisonous or deleterious to fish been allowed to flow into your rivers?

8.—What steps were taken in 1884 to prevent pollution from mines and factories, or sewage from towns, from entering your rivers? Have such steps proved successful?

9.—What instruments for the capture of salmon were licensed in 1884? How many of each of these instruments were licensed? What was the rate of licence duty on each? How many of these were issued for public and how many for private waters?

10.—What instruments for the capture of trout and char were licensed in 1884? How many of each of these instruments were licensed? What was the rate of licence duty upon each?

11.—Were any "general" licences issued in 1884? If so, how many? And what was the amount of revenue raised in this way: (a.) For salmon? (b.) For trout?

12.—Were any prosecutions instituted by your board under the Salmon and Fresh Water Fisheries Acts in 1884? For what offences were they instituted? What has been their result?

13.—Have you any reason to believe that illegal fishing is prevalent in your district?

14.—State the number of water bailiffs employed in your district in 1884.

15.—Were any gratings attached to mill-lades or other artificial channels in your district during 1884? Are they effective?

ANSWERS TO THE FOREGOING QUESTIONS.

N.B.—In those cases where the answer to any of the above questions consists of a simple negative, it has been omitted from the following return.

The answers to question 14 are tabulated in Appendix VII., p. 99.

In the arrangement of the following answers the rivers are taken in their order on the line of coast, beginning at the north-west.

EDEN DISTRICT.

EDEN.

1.—(a.), (b.), (c.) An average season.

4.—Yes. 1,079 diseased salmon were taken from the rivers within the District by the water bailiffs and buried; this is a considerable decrease from the two previous years.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Haaf or heave net - -	130	1 <i>l.</i> 10 <i>s.</i>	£ <i>s.</i> <i>d.</i> 195 0 0
Hang or drift net - -	32	5 <i>l.</i> for 300 yards, and 2 <i>s.</i> 6 <i>d.</i> for every additional 40 yards.	168 17 6
			£363 17 6

PRIVATE WATERS.			
Coracle net - - -	2	2 <i>l.</i> 5 <i>s.</i>	£ <i>s.</i> <i>d.</i> 4 10 0
Hang or drift net - -	6	3 <i>l.</i>	18 0 0
Ditto - - -	13	5 <i>l.</i>	65 0 0
Rod and line - - -	170	1 <i>l.</i> 1 <i>s.</i>	178 0 0
Ditto - - -	29	10 <i>s.</i>	14 10 0
Ditto - - -	18	7 <i>s.</i> 6 <i>d.</i>	6 0 0
Ditto - - -	58	5 <i>s.</i>	14 0 0
Ditto (single handed) - -	35	5 <i>s.</i>	8 15 0
			£309 5 0

10:—

Rod and line (season) - -	1,322	2 <i>s.</i> 6 <i>d.</i>	£ <i>s.</i> <i>d.</i> 165 5 0
Ditto (weekly) - - -	117	1 <i>s.</i>	5 17 0
Shoulder net - - -	17	15 <i>s.</i>	12 15 0
Draft net - - -	4	1 <i>l.</i>	4 0 0
			£187 17 0

11.—(a.) Three. One at 26*l.* 5*s.*; one at 15*l.*; one at 2*l.* 2*s.* Total 43*l.* 7*s.*

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Unclean salmon in possession.	Cumberland Ward, Carlisle.	2	£ <i>s.</i> <i>d.</i> 1 0 0	£ <i>s.</i> <i>d.</i> 0 7 0	—	—
Ditto - - -	"	1	2 0 0	0 10 6	—	—
Ditto - - -	"	1	3 0 0	0 11 6	—	—
Ditto - - -	"	1	0 10 0	0 6 6	—	—
Ditto - - -	"	1	1 10 0	0 10 6	—	—
Ditto - - -	"	2	0 10 0	0 7 6	—	—
Ditto - - -	"	3	0 10 0	0 6 0	—	—
Disturbing salmon on spawning beds.	"	4	0 10 0	0 6 0	—	—
Ditto - - -	"	1	1 0 0	0 9 6	—	1
Ditto - - -	"	2	0 10 0	0 11 6	—	—
Ditto - - -	"	1	0 10 0	0 11 0	—	—
Ditto - - -	"	2	0 10 0	0 6 0	—	—
Ditto - - -	"	1	1 0 0	0 7 0	—	—
Ditto - - -	"	1	2 0 0	0 7 0	—	—
Ditto - - -	"	3	0 10 0	0 9 6	—	—
Ditto - - -	"	1	1 0 0	0 11 6	—	—
Ditto - - -	"	1	2 0 0	0 11 6	—	—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Salmon roe in possession.	Carlisle	1	£ s. d. 1 0 0	£ s. d. —	—	—
Using salmon roe	"	2	0 10 0	0 8 0	—	—
Killing salmon without license.	"	1	0 10 0	0 6 0	1	—
Taking the young of salmon.	"	1	0 10 0	0 11 6	—	—
Poisoning salmon	{ Brampton, Carlisle, Penrith	1	0 2 6	0 14 3	—	—
Fishing without licence for trout.		1	0 1 0	0 14 3	—	—
Ditto		1	0 5 0	0 9 6	—	—
Ditto	Kirkby Stephen.	1	0 5 0	—	—	—
Using illegal net	Wigton	2	5 0 0	--	—	—

SECOND OFFENCE.

Disturbing salmon on spawning beds.	Cumberland Ward.	1	0 10 0	0 6 0	—	—
Using gaff	"	1	2 0 0	0 6 0	—	—
Ditto	"	1	2 0 0	0 14 0	—	—
Ditto	"	1	2 0 0	0 11 0	—	—
Ditto	"	1	2 10 0	0 11 6	—	—
Ditto	"	1	5 0 0	0 14 6	—	—
Ditto	"	1	5 0 0	0 11 6	—	—
Ditto	"	1	2 10 0	0 6 6	—	—
Unclean salmon in possession.	"	1	5 0 0	0 12 6	—	—
Ditto	"	1	5 0 0	0 14 6	—	—
Using gaff	"	1	2 0 0	0 7 0	—	—
Fishing in close time with rod and line.	"	1	1 0 0	0 11 0	—	—
Foulhooking salmon	"	1	5 0 0	0 13 0	—	—

THIRD OR SUBSEQUENT OFFENCE.

Unclean salmon in possession.	Carlisle, Cumberland Ward.	1	0 10 0	0 6 6	—	—
Using gaff	"	1	5 0 0	0 7 6	—	—
Ditto	"	1	5 0 0	0 7 0	—	—

DERWENT.

DERWENT (CUMBERLAND) DISTRICT.

4.—Yes, and there are a few diseased fish still in the river (31st December 1884), but there is no increase in the disease since the previous year. A few weeks ago a heavy water took a great quantity of these diseased fish down to the sea.

6.—A new pass has been put in the Branthwaite Weir, and has so far proved successful.

8.—A committee of the Board was deputed to visit the lead mines at Threlkeld, and by appointment met the managing director there, who promised to erect catch pits below the outputs from the mines. This was done and the committee inspected the work, but were not satisfied that the best practicable means had been used to prevent the pollution. The matter is at present under the consideration of the Board.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PRIVATE WATERS.

Baulk, box, crib, cruive, &c.	1	10 <i>l.</i>	£ s. d. 10 0 0
Draft or seine net	1	5 <i>l.</i>	5 0 0
Rod and line	122	1 <i>l.</i>	122 0 0
Ditto	102	10 <i>s.</i>	51 0 0
Ditto	26	5 <i>s.</i>	6 10 0
			£194 10 0

10:—

Rod and line	342	5 <i>s.</i>	£ s. d. 85 10 0
Ditto	108	2 <i>s. 6d.</i>	13 10 0
Draft net	2	1 <i>l. 13s. 4d.</i>	3 6 8
			£102 6 8

11.—(a.) One at 12*l.*; one at 5*l.*; one at 3*l.* Total 20*l.*

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Having unclean salmon in possession.	Cockermouth	1	£ s. d. 5 0 0	£ s. d. 0 9 6	—	—
Having clickhook in possession.	"	1	4 9 0	0 11 0	—	—
Using clickhook	"	1	1 10 6	0 9 6	—	—
Fishing in weekly close time.	"	2	7 13 0	0 12 0	—	—
Using clickhook	"	1	1 6 6	0 13 0	—	—
Ditto	"	2	5 0 0	0 8 0	—	—
Adding and abetting ditto.	"	1	5 0 0	0 11 0	—	—
Fishing in private waters.	"	2	0 0 6	0 9 6	—	—
Fishing in close season	"	1	4 9 0	0 11 0	—	—
Having clickhook in possession.	"	1	5 0 0	0 11 0	—	—
Using clickhook	"	1	4 10 6	0 9 6	—	—
Aiding and abetting ditto.	"	1	5 0 0	0 7 6	—	—
Ditto	"	1	4 12 6	0 7 6	—	—
Having unseasonable salmon in possession.	"	1	0 10 6	0 9 6	—	—
Ditto	Workington	1	2 0 0	—	—	—
Ditto	"	2	4 6 6	0 13 6	—	—
Having clickhook in possession.	"	1	4 4 6	0 15 6	—	—
Ditto	"	1	3 18 0	1 2 0	—	—
Ditto	"	1	5 1 0	0 19 0	—	—
Illegally killing salmon	"	1	5 0 0	0 13 6	—	—
Using a snatch to take salmon.	"	1	3 1 0	—	—	—
Ditto	"	1	2 0 0	—	—	—
Illegal netting	Keswick	2	2 12 2	0 7 8	—	—
Ditto	Maryport	1	2 1 0	—	—	—

13.—Yes, there is always a great deal of poaching in this district.

WEST CUM-
BERLAND.

WEST CUMBERLAND DISTRICT.

1.—(a.), Increased; (b.), (c.), diminished.

2:—

Salmon.		Trout (migratory).		Total.	
No.	lbs.	No.	lbs.	No.	lbs.
(a.) 502	4,229	909	2,683	1,471	6,892
(b.) 115	897	1,500	1,250	1,615	2,147
617	5,126	2,409	3,913	3,066	9,039

3.—Trout have increased.

4.—Yes, early in July 1884. The number of diseased fish taken out of the rivers since last report are:—

Salmon	-	-	-	-	58
Migratory trout	-	-	-	-	10
Smelts	-	-	-	-	4
Brandling	-	-	-	-	1

73

7.—Yes. A coal washing machine has been put up at Bowthorn Colliery the water from which thickened with coal dust flows into a filter and then into the River Keekle.

The water from the Moresby Coal Company's coal-washing machine still flows into the River Keekle (reported last year) and the dyewater from Mr. Ainsworth's Factory is emptied into the milldam which communicates with the River Ehen (reported last season) and anglers complain that these impurities prevent them catching fish.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Draft net - - - -	3	5 <i>l</i> .	£ s. d. 15 0 0
PRIVATE WATERS.			
Draft net - - - -	8	3 <i>l</i> .	£ s. d. 24 0 0
V weir or garth - - -	2	5 <i>l</i> .	10 0 0
Rod and line (season) - -	247	10 <i>s</i> .	123 10 0
Ditto (weekly) - - -	10	5 <i>s</i> .	2 10 0
Ditto (daily) - - -	9	2 <i>s</i> . 6 <i>d</i> .	1 2 6
			£161 2 6

11.—(a.) One at 20*l*.; one at 10*l*.; one at 7*l*. Total 37*l*.

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Offence against bye-laws.	Whitehaven	1	1 <i>s</i> .	1 <i>l</i> . 9 <i>s</i> . 0 <i>d</i> .	—	—
24 & 25 Vict. c. 109. s. 8.	"	1	1 <i>l</i> . 4 <i>s</i> .	16 <i>s</i> .	—	—
Ditto -	"	2	1 <i>l</i> . 6 <i>s</i> .	14 <i>s</i> .	—	—
36 & 37 Vict. c. 71. s. 36.	"	1	2 <i>s</i> . 6 <i>d</i> .	17 <i>s</i> . 6 <i>d</i> .	—	—
Weekly close time -	"	2	6 <i>d</i> .	1 <i>l</i> . 9 <i>s</i> . 6 <i>d</i> .	—	1
Fishing in private waters.	"	1	1 <i>l</i> . 1 <i>s</i> . 6 <i>d</i> .	18 <i>s</i> . 6 <i>d</i> .	—	—
Ditto - -	"	1	1 <i>s</i> .	1 <i>l</i> . 9 <i>s</i> . 6 <i>d</i> .	—	—

13.—Illegal fishing is on the decrease.

15.—Yes. Gratings were attached to the head and tail of Mill Race at Gosforth. The one at the tail of Low Mill Race had to be taken out in the latter end of October as it was choked up with leaves. Otherwise they were effective.

KENT DISTRICT.

KENT.

1.—(a.) Increased; (b.) diminished; (c.) increased.

4.—Yes. It appeared to a slight extent in the spring months in both the Kent and Leven, but died out later on in the season, and there is no evidence of its existence this autumn, or up to date of writing (22nd December 1884).

6.—A series of passes on the River Leven to facilitate the passage of sea trout early in the season to Lake Windermere were made, but the summer was so dry they have not had a fair trial.

7.—Nothing new. It has been suggested that the sewage and waste running into the sea at Ulverston and from the town of Ulverston, causes damage, but the evidence on this point is not clear, though the evidence that such pollution exists is ample.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

			£ s. d.
Baulk, box, crib, cruive, &c.	2	10l.	20 0 0
Hang or drift net	15	5l.	75 0 0
Rod and line	184	10s.	92 0 0
Ditto (weekly)	2	5s.	0 10 0
			<hr/> £177 10 0

10:—

			£ s. d.
Rod and line	1,350	2s. 6d.	169 17 6
Plumb line	72	5s.	18 0 0
Cross line	5	15s.	3 15 0
Draft net	14	1l. 13s. 4d.	23 6 8
			<hr/> £214 19 2

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Unlawfully taking young salmon.	Bootle	1	—	—	—	—
Fishing for trout without a licence.	"	1	—	—	—	—
Fishing for trout with net without a licence.	Kendal	1	1l. and costs.	—	—	—
Ditto	"	1	2l. and costs.	—	—	—
Grappling trout	Ambleside	1	5l. and costs.	—	—	—
Unlawful possession of salmon spear.	Lonsdale	2	40s. and 10s. and costs.	—	—	—
Using spear for killing salmon.	North	1	50s. and costs.	—	—	—

LUNE.

LUNE DISTRICT.

- 1.—(a.) Increased; (b.) diminished; (c.) increased.
 3.—Yes. Trout have increased.
 4.—Yes, but not so bad as the previous year in proportion to the quantity of fish in the rivers.
 8.—The pollutions at Sedbergh remain the same as last year, and the Board have drawn the attention of the Local Government Board to them, and they are corresponding with the Sedbergh Rural Sanitary Authority.
 9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Haaf or heave net - - -	30	3l.	£ 90 0 0
Ditto - - - - -	18	1l. 10s.	27 0 0
Hang or drift net - - -	6	7l.	42 0 0
Ditto - - - - -	6	6l.	36 0 0
Ditto - - - - -	2	5l.	10 0 0
Draft or seine net - - -	6	5l.	30 0 0
Ditto - - - - -	3	2l.	6 0 0
			£241 0 0

PRIVATE WATERS.			
Baulk, box, crib, cruive, &c. -	1	10l.	£ 10 0 0
Haaf or heave net - - -	6	1l. 10s.	9 0 0
Draft or seine net - - -	5	5l.	25 0 0
Rod and line - - - - -	9	5s.	2 5 0
Do. - - - - -	11	10s.	5 10 0
Do. - - - - -	61	1l.	61 0 0
			£112 15 0

11.—(a.) Six. One at 10l.; two at 7l.; one at 5l.; two at 4l. Total 37.
 12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

			£ s. d.	£ s. d.		
Possession of a gaff -	Lancaster County.	2	4 0 0	2 9 0	—	—
Ditto - - - - -	"	1	3 0 0	1 4 6	—	—
Possession of unseasonable salmon.	Lancaster Borough.	1	5 0 0	1 0 0	—	—
Ditto - - - - -	"	1	3 0 0	1 3 0	—	—
Poisoning fish in River Birbeck.	Shap, Westmorland.	1	5 0 0	1 6 0	—	—
Using illegal sized net.	St. Michael's on Wyre.	1	0 5 0	1 13 0	—	—
Attempting to catch salmon in annual close time with net.	Kirkby Lonsdale.	1	2 0 0	1 11 9	—	—

SECOND OFFENCE.

Possession of unseasonable salmon.	Lancaster County.	1	4 0 0	1 4 6	—	—
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13.—Yes; a good deal of poaching.

RIBBLE DISTRICT.

RIBBLE.

- 1.—(a.), (b.), (c.) Decreased.
 2.—(a.) 4,034 salmon, weighing 48,408 lbs. (b.) 20 salmon, weighing 240 lbs. Total, 48,648 lbs.
 3.—We have no return, but are informed there is an increase in number in the river by reason of the Board breeding trout.
 4.—Very slightly.
 9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Haaf or heave net - - -	10	5 <i>l</i> .	<i>£</i> s. d. 50 0 0
Hang or drift net - - -	27	5 <i>l</i> .	135 0 0
			<i>£</i> 185 0 0

PRIVATE WATERS.

Draft or seine net - - -	6	2 <i>l</i> .	<i>£</i> s. d. 12 0 0
Ditto - - - - -	1	5 <i>l</i> .	5 0 0
Rod and line - - - -	211	1 <i>l</i> .	211 0 0
			<i>£</i> 228 0 0

11.—Two; one at 6*l*. 10*s*., and one at 8*l*. Total, 14*l*. 10*s*.

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Fishing with light and spear.	Clitheroe	—	<i>£</i> s. d. —	<i>£</i> s. d. —	—	2
Fishing in close time -	"	4	{ Two at 2 <i>l</i> . 10 <i>s</i> . Two at 2 <i>l</i> .	—	—	2
Using a gaff - - -		2		—	—	—
Fishing with illegal net.	Kirkham	2	2 0 0	—	—	—
Taking salmon without licence.	Leyland	1	2 10 0	—	—	1

* One of the Defendants absconded.

DEE DISTRICT.

DEE.

- 1.—(a.) Increased. (b.) Diminished. (c.) Average.
 4.—Yes, to a certain extent, but not so heavy as last year. Still it killed a number of fish in the inland waters.
 6.—Yes, at Pentrefelin near Llangollen, the pass has been newly built, and a slight repair has also been done at Llangollen Weir, both of which have proved successful.
 7, 8.—No new mines or factories have been opened. The waste tip at Muspratt's Chemical Works at Flint has been partly washed away by the alteration or shifting of the channel of the river. The proprietors have now discontinued tipping the waste in the channel.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	85	5l.	£ s. d. 425 0 0
Trammel net - - -	7	10l.	70 0 0
			£495 0 0

PRIVATE WATERS.

Coracle net - - -	15	2l. 5s.	£ s. d. 33 15 0
Rod and line - - -	51	1l.	51 0 0
Ditto (weekly) - - -	10	10s.	5 0 0
			£89 15 0

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Being in possession of 80 salmon fry.	Bala	1	3l. and costs.	—	—
Being in possession of young of salmon in annual close time.	Chester City.	3	1l. each and costs. Committed to gaol for 14 days each in default.	—	—
Being in possession of unseasonable salmon.	"	1	10s. and costs. Committed to gaol for seven days in default.	—	—
Ditto - - -	"	4	1l. and costs.*	—	—
Ditto - - -	Wrexham	1	1l. and costs, and 10s. each for two fish.	—	—
Ditto - - -	Chester Castle.	3	1l. each and costs.	—	—
Assaulting water bailiff in execution of his duty.	Chester City.	1	10l. and costs. Committed to gaol for two months hard labour in default.	—	—
Ditto - - -	"	1	1l. and costs.†	—	—
Refusing to come ashore to have boat searched.	Northop	2	5s. each and costs.	—	1

SECOND OFFENCE.

Refusing to come ashore to have boat searched.	Northop	1	5s. and costs.	—	—
Fishing in weekly close time.	Hawarden	2	5s. each and costs.	—	—
Fishing in annual close time.	Bangor Isycoed.	2	2l. 10s. each and costs.	—	—

* One defendant committed to gaol for 14 days in default.

† And bound over in 10l. to keep the peace. Another defendant absconded, and a warrant has been issued for his apprehension.

THIRD OR SUBSEQUENT OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Being in possession of unseasonable salmon.	Chester City.	1	5 <i>l.</i> and costs, and 1 <i>l.</i> each for two fish. Committed to gaol for two months hard labour in default.	—	—	—
Refusing to come ashore to have boats searched.	Northop	1	5 <i>s.</i> and costs.	—	—	—

13.—Yes, the fine mesh net and the trammel net are much used for the ostensible purpose of fishing for flukes and other fish, by which means a large number of salmon are caught.

CLWYD AND ELWY DISTRICT.

CLWYD AND ELWY.

1.—(a.), (b.), (c.) Decreased.

2 :—

Salmon.		Trout (migratory).		Total.	
No.	lbs.	No.	lbs.	No.	lbs.
(a.) 2,300	9,200	—	—	2,300	9,200
(b.) 100	350	250	250	350	600
Total 2,400	9,550	250	250	2,650	9,800

3.—Yes.

4.—Only a few diseased fish have been seen.

5.—One old weir, known as the “ Bishop Mill Dam,” on the River Elwy, rebuilt.

Also one old weir known as the “ Pontnewydd,” or “ Mrs. William Wynn’s Mill Dam,” on the same stream, repaired, and a new salmon pass built.

6.—One old pass renewed in the weir called the “ Bishop Mill Dam” above referred to, and inspected by Mr. Fryer and reported as badly constructed and inefficient.

One new salmon pass on the same stream known as “ Mrs. William Wynn’s Mill Dam,” which has been built since Mr. Fryer’s inspection, and is, I believe, most successful.

9 :—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net	- -	13	3 <i>l.</i> 10 <i>s.</i>	£ s. d. 45 10 0
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PRIVATE WATERS.

Rod and line	- - -	51	1 <i>l.</i>	£ s. d. 51 0 0
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12.—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

			£ s. d.	£ s. d.		
Having unseasonable salmon in possession.	Denbigh	1	0 10 0	0 14 0	—	—
Ditto - - -	St. Asaph	1	1 0 0	0 9 6	—	—
Salmon poaching - -	Denbigh	1	0 2 6	0 16 6	—	1
Ditto - - -	"	2	0 10 0	1 7 3	—	—
Ditto - - -	"	2	0 2 6	0 12 3	—	—
Fishing without a licence.	Ruthin	1	2 0 0	1 0 0	—	—
Taking unseasonable salmon.	St. Asaph	2	1 0 0	0 7 6	—	—
Ditto - - -	"	1	1 0 0	0 9 6	—	—
Using illegal net - -	Ruthin	1	—	—	1	—
Killing salmon without a licence.	"	1	1 0 0	1 0 0	—	—
Disturbing salmon in close time.	St. Asaph	1	0 5 0	0 10 6	—	1
Refusing to be searched by water bailiff.	"	—	—	—	—	1
Using gaff to catch salmon.	Abergele	1	1 0 0	1 3 6	—	—

SECOND OFFENCE.

Having salmon roe in possession.	Denbigh	1	0 5 0	0 17 0	—	—
Having unseasonable salmon in possession.	"	2	2 0 0	0 14 0	—	—
Killing salmon without a licence.	Ruthin	1	2 10 0	1 0 0	—	—
Using gaff to catch salmon.	Abergele	1	2 0 0	1 12 0	—	—

THIRD OR SUBSEQUENT OFFENCE.

Fishing without a licence.	Caerwys	1	2 10 0	0 11 4	—	—
Ditto - - -	Ruthin	1	5 0 0	0 7 4	—	—
Ditto - - -	"	2	1 0 0	0 14 8	—	—
Using illegal net - -	"	—	—	—	2	—
Using a fixed engine to catch salmon.	St. Asaph	1	2 10 0	0 9 0	—	—
Ditto - - -	"	1	2 10 0	0 7 0	—	—

13.—Yes; see offences.

CONWAY.

CONWAY DISTRICT.

1.—(a.) No returns. (b.), (c.) Diminished.

The Conservators attribute the reduced take of fish entirely to the drought and not to the salmon disease, which appeared too late in the season to affect the rod fishing.

2.—(b.) 118 salmon, weighing 1,186 lbs.

4.—Yes; it appeared later in the year than in 1883, but has been very bad for some time, and is so at the present moment. (5th January 1885.)

9:—

PUBLIC WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
			£ s. d.
Coracle net - - - -	1	2s.	2 0 0
Draft net - - - -	6	3s.	18 0 0
Weir - - - -	2	3s.	6 0 0
Basket - - - -	1	1s.	1 0 0
Rod and line (season) - - - -	12	1s.	12 0 0
Ditto (monthly) - - - -	4	10s.	2 0 0
Ditto (fortnightly) - - - -	11	6s.	3 6 0
Ditto (weekly) - - - -	42	3s.	6 6 0
Ditto (daily) - - - -	65	1s.	3 5 0
			£53 17 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Unlawfully using a gaff	Nant Conway Petty Sessions.	—	—	—	1	—
Ditto - - - -	"	1	5s. and costs.	—	—	—
Using an otter - - - -	"	1	2s. 10s. and costs.	—	—	—
Unlawfully using a gaff	Llwehddulas Petty Sessions.	1	2s. 10s. including costs.	—	—	—
Fishing with an illegal net.	"	1	5s. and costs.	—	—	—
Exposing salmon for sale.	"	1	5s. and costs.	—	—	—
Ditto - - - -	"	1	1s. 5s. and costs.	—	—	—
Fishing with an illegal net.	"	1	1s. 5s. and costs.	—	—	—

13.—Yes.

SEIONT DISTRICT.

SEIONT.

1.—(a.) Increased. (b.) Decreased for want of floods. (c.) Increased.

2:—

Salmon.		Trout (migratory).		Total.	
No.	lbs.	No.	lbs.	No.	lbs.
(a.) 1,370	9,998	—	—	1,370	9,998
(b.) 59	600	309	309	368	909
1,429	10,598	309	309	1,738	10,907

3.—The trout fishing this season was not a good one in consequence of the water in the rivers being so low during the whole of the season.

4.—Only in a very few cases.

5.—No new ones have been made; repairs have been made. Nearly one thousand spiles have been driven into the bed of the different rivers to prevent netting.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Weir - - - -	1	10 <i>l.</i>	£ s. d. 10 0 0
Draft or seine net - - - -	7	5 <i>l.</i>	35 0 0
Rod and line - - - -	33	1 <i>l.</i> 1 <i>s.</i>	33 12 0
Ditto - - - -	10	10 <i>s.</i> 6 <i>d.</i>	5 5 0
Ditto - - - -	4	2 <i>s.</i> 6 <i>d.</i>	0 10 0
			£34 7 0

10:—

Rod and line - - - -	537	5 <i>s.</i>	£ s. d. 84 5 0
Ditto - - - -	23	2 <i>s.</i> 6 <i>d.</i>	3 10 0
Ditto - - - -	89	1 <i>s.</i>	4 9 0
			£92 4 0

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against w Charge hom withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Fishing during close time for trout.	Mennai Bridge (County Sessions).	3	2 <i>s.</i> 6 <i>d.</i> each.	—	—	—
Attempting to kill salmon.	Carnarvon (County Sessions).	—	—	—	—	3
Fishing illegally with net for trout.	"	—	—	—	3*	—
Having salmon in possession during close time.	"	2	1 <i>l.</i> each and costs.	—	—	—
Attempting to kill salmon during close time.	"	—	—	—	—	1

SECOND OFFENCE.

Attempting to kill salmon.	Carnarvon (County Sessions).	2	3 <i>l.</i> †	—	—	—
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* On paying 1*l.* 1*s.*

† Both sent to jail for a month in default.

13.—Net fishing with small-meshed nets commences immediately after the salmon netting is over, nominally for flukes, codlings, &c., but really for salmon. This gives a great deal of extra trouble to our water bailiffs, as they only fish at night when the tide serves. Only on one occasion (and our men have seen them draw scores of times) did they catch any quantity of flukes, &c., but they constantly took in the net two, three, and sometimes five or six salmon. These were of course carefully returned to the sea by our men.

15.—We have gratings to nearly every one of the mill leads, and all will be up shortly.

DWYFACH DISTRICT.

DWYFACH.

1.—(a.), (b.) Diminished, as compared with last year.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Hang or drift net - - -	5	5l.	£ s. d. 25 0 0
PRIVATE WATERS.			
Rod and line - - - -	3	1l. 1s.	£ s. d. 3 3 0
Ditto - - - -	1	10s.	0 10 0
			£3 13 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Netting during weekly close time.	Pwllheli -	4	s. d. 2 6 each and costs.	—	—	—

13.—Yes ; a good deal of poaching goes on.

DOVEY.

DOVEY.

1.—(a.), (b.), (c.) I believe it is about the same, but no account has been kept.

6.—Yes ; one, and has proved successful.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Draft or seine net - - -	6	5l.	£ s. d. 30 0 0
PRIVATE WATERS.			
Baulk, box, crib, cruive, weir, &c.	1	10l.	10 0 0
Coracle net - - - -	1	2l.	2 0 0
Draft or seine net - - -	5	5l.	25 0 0
Rod and line (season) - -	81	1l.	81 0 0
Ditto (monthly) - - -	65	10s.	32 10 0
Ditto (weekly) - - -	101	5s.	25 5 0
Ditto (daily) - - -	20	2s. 6d.	2 10 0
			£178 5 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Using gaff - -	Penrhyndeudraeth.	3	£ s. d. 1 10 0	£ s. d. 1 10 0	—	—
Fishing without licence	Barmouth	1	12. and 12. value of fish taken.	1 13 0	—	—
Using gaff - -	Dolgelley	3	1 10 0	2 8 0	—	3
Ditto - - -	"	2	2 0 0	2 10 0	—	—
Taking unseasonable salmon.	"	—	—	—	8	—
Disturbing salmon on spawning beds.	"	2	4 0 0	3 1 0	—	—
Having gaff in possession to take salmon.	"	2	1 0 0	2 3 0	—	—
Ditto - - -	"	1	0 10 0	1 18 0	—	—
Using net without licence.	"	1	10 0 0	2 8 0	—	—
Trying to take salmon	"	2	2 0 0	2 1 6	—	—
Fishing with rod without licence.	"	1	0 5 0	1 13 6	—	—
Aiding and abetting ditto.	"	—	—	—	—	1
Attempting to catch salmon.	"	2	1 0 0	2 3 8	—	—
Using gaff - -	Aberdovey	2	0 13 0	1 7 0	—	—
Ditto - - -	"	1	1 1 6	0 18 6	—	—
Ditto - - -	Machynlleth	1	2 9 0	0 11 0	—	11
Ditto - - -	"	1	0 9 0	0 11 0	—	—
Ditto - - -	"	1	0 10 0	0 10 0	—	—
Fishing during close season.	"	2	0 19 0	1 1 0	—	2
Assaulting water bailiff in execution of duty.	"	—	—	—	—	3
Aiding and abetting ditto.	"	—	—	—	—	1
Using dynamite - -	"	—	—	—	—	3
Taking fish other than by rod and line.	"	3	3 0 0	1 7 0	—	—
Having possession of unseasonable salmon.	"	1	0 9 0	0 11 0	—	—
Having possession of gaff.	"	1	2 0 0	0 10 6	—	—
Fishing without a licence.	Portmadoc	7	0 5 0	Including costs.	7	—

13.—Yes.

AYRON.

AYRON DISTRICT.

1.—(a.) Yes, inasmuch as there were two nets used, as against none last year. (b.) No, owing to dryness of weather.

3.—The Freshwater Fisheries Act, 1878, has very little effect in this district. The take of non-migratory trout was very small in 1884, owing to the unfavourable state of the water, and the weather being very wet and cold in March, and very dry from April onwards.

9:—

PUBLIC WATERS..

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Baulk, box, crib, cruive, &c. -	5	12.	£ s. d. 5 0 0
Pole net - - - - -	2	54.	10 0 0
			£15 0 0

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Rod and line - - -	19	1 <i>l</i> .	£ s. d. 19 0 0
Ditto - - -	2	10 <i>s</i> .	1 0 0
Ditto - - -	16	5 <i>s</i> .	4 0 0
			£24 0 0

10:—

Rod and line - - -	19	5 <i>s</i> .	£ s. d. 4 15 0
Ditto - - -	8	2 <i>s</i> . 6 <i>d</i> .	1 0 0
Ditto - - -	23	1 <i>s</i> .	1 8 0
			£27 3 0

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Taking young of salmon.	Aberayron.	4	5 <i>s</i> . each	—	—	—
Using a spear -	—	—	—	—	—	1
Aiding and abetting in using a spear.	—	—	—	—	—	1

SECOND OFFENCE.

Taking salmon with unlicensed instrument.	—	—	—	—	1	—
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THIRD OFFENCE.

Taking salmon otherwise than with rod or line within 50 yards above a weir.	—	1	5 <i>l</i> .	11 <i>s</i> . 6 <i>d</i> .	—	—
Taking salmon with unlicensed instrument.	—	—	—	—	1	—
Using a snatch -	—	1	5 <i>l</i> .	17 <i>s</i> . 6 <i>d</i> .	1	—

13.—To a certain extent it does prevail, but on the whole to a less extent than in 1883.

TEIFY DISTRICT.**TEIFY.**

1.—(a.) Increased. (b.) About equal to that in 1883. (c.) Increased.

3.—Increased.

5.—Yes; the weir at Newcastle Emlyn has been so raised and altered as to give increased obstruction to fish. Professor Huxley inspected this weir on the 2nd of October last, when it was arranged that a fish pass should be constructed by the owner of the weir, who is also owner of the land adjoining.

This has not yet been done; the reason for the delay given by the landowner's agent being that since the said date there has been and is too much water in the river to do anything towards making the pass, and that it will be necessary to wait until the spring. There was an ample flow of water over the weir when last I saw same on the 19th ult., and salmon at that time could have no difficulty in getting up the river; it would be otherwise though if the water was low in the river.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Coracle net - - -	35	2l. 5s.	£ s. d. 78 15 0
Draft or seine net - - -	21	5l.	105 0 0
			<hr/> £183 15 0

PRIVATE WATERS.

Rod and line (season) - -	57	1l.	£ s. d. 57 0 0
Ditto (monthly) - -	2	10s. 6d.	1 1 0
Ditto (fortnightly) - -	25	5s.	6 5 0
			<hr/> £64 6 0

10:—

Rod and line - - -	614	2s. 6d.	£ s. d. 78 15 0
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12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Using a light - -	Tregaron	1	£ s. d. 2 10 0	£ s. d. 0 13 6	—	—
Using a gaff - -	"	1	2 10 0	0 13 6	—	—
Using fish roe - -	Penrhiwpal	1	0 10 0	1 0 0	—	—
Ditto - - -	"	1	0 10 0	1 6 3	—	—
Ditto - - -	"	1	0 10 0	1 15 3	—	—
Ditto - - -	"	1	0 10 0	1 9 0	—	—
Fishing without a licence for trout.	Cardigan	1	0 10 0	0 9 6	—	—
Fishing for trout during the annual close season.	Pontarseli	1	0 1 0	0 13 0	—	—
Having in possession the young of salmon.	Cardigan	2	0 5 0	0 9 6	—	—
Ditto - - -	"	1	1 5 0	0 11 6	—	—
Ditto - - -	"	1	0 5 0	0 8 3	—	—
Taking trout without licence.	Lampeter	1	0 2 0	0 14 0	—	—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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SECOND OFFENCE.

Using fixed engines -	Cardigan	1	£ s. d. 1 0 0	£ s. d. 0 10 6	—	—
Having in possession the young of salmon.	"	1	2 10 0	0 8 6	—	—
Ditto -	Lampeter	—	—	—	1 on payment of 14s. costs.	
Using a fixed engine -	Newport	—	—	—		
Aiding and abetting in above.	"	—	—	—	—	2
Fishing during the annual close season.	Cardigan	1	2 10 0	0 19 2	—	—

THIRD OR SUBSEQUENT OFFENCE.

Using fixed engines for catching salmon.	Cardigan	1	5 0 0	0 10 6	2, on payment of 10s. 6d. costs.	
Killing salmon without licence.	Newport	—	—	—		2
Aiding and abetting in above.	"	—	—	—		1
Fishing during the annual close season.	Cardigan	1	5 0 0	0 19 2	—	—

In addition to the above two defendants absconded.

13.—Not so prevalent this year as it has been.

CLEDDY DISTRICT.

CLEDDY.

- 1.—(b.), (c.) Increased.
- 2.—250 salmon with rod.
- 3.—Increased.
- 9:—

Name of Instrument.	Number licensed.	Rate at which licenced.	Amount of licence duty received.
PUBLIC WATERS.			
Coracle net - - -	4	1l.	£ s. d. 4 0 0
Draft or seine net - - -	4	5l.	20 0 0
Compass net - - -	17	1l. 1s.	17 17 0
			£41 17 0

PRIVATE WATERS.

Draft or seine net - - -	2	1l. 10s.	£ s. d. 3 0 0
Rod and line - - -	38	10s. 6d.	19 19 0
			£22 19 0

10:—

Rod and line - - -	153	3s. 6d.	£ s. d. 26 15 6
Ditto - - -	3	2s. 6d.	0 7 6
Ditto - - -	5	1s.	0 5 0
			£27 8 0

12 :—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Having salmon in possession for sale during close time.	Magistrates of Narberth Petty Sessional District, County Pembroke.	—	—	—	2	—
Having in possession unclean salmon.	"	2	1 <i>l.</i> 1 <i>s.</i> each	—	—	—

13.—Yes, to a considerable extent.

TOWY.

TOWY DISTRICT.

1.—(a.) Increased in lower parts, and in the sea. (b.) Decreased as compared with 1883. (c.) Quite equal to 1883 as far as nets were concerned, but the take by rods was considerably less.

2.—(a.) 115,000 lbs. (b.) 200 salmon, weighing 2,000 lbs., and 500 migratory trout, weighing 750 lbs. Total 117,750 lbs.

It was stated in a local newspaper that 15 rods at Llandilo had netted 121 salmon and 91 sewin, although some of them fished only a few days. In the Tawe there was not a single fresh until after the close of rod-fishing.

3.—It has not increased, but Boards are now able to check many malpractices which formerly the law did not reach.

4.—There was very little disease, and it had entirely disappeared by the middle of March.

6.—The new pass at Cwmgwilly weir has been slightly improved by putting in brakes, as recommended by Mr. Fryer, but the heavy gravid fish are still unable to ascend. The Board is still unable to concur in its approval by the Secretary of State.

8.—There was a case of pollution on the Loughor reported to the Board, but, as the proprietors had been in possession of the tinworks only three weeks, no proceedings were taken against them. The Board remonstrated, and there has been no further cause for complaints.

9 :—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

			£ s. d.
Baulk, box, crib, cruive, &c.	1	3 <i>l.</i>	3 0 0
Coracle net	51	2 <i>l.</i> 2 <i>s.</i>	107 2 0
Draft or seine net	20	5 <i>s.</i>	100 0 0
Ditto	6	2 <i>l.</i> 10 <i>s.</i>	15 0 0
Wade net	3	2 <i>l.</i>	6 0 0
Lamp net	28	10 <i>s.</i>	14 0 0
			£246 2 0

PRIVATE WATERS.

			£ s. d.
Coracle net	9	2 <i>l.</i> 2 <i>s.</i>	18 18 0
Two-pole net	4	2 <i>l.</i>	8 0 0
Rod and line	173	1 <i>l.</i> 1 <i>s.</i>	181 13 0
			£208 11 0

10:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Rod and line - - -	1,433	2s. 6d.	£ s. d. 179 2 6
Trammel net - - -	1	5l.	5 0 0
Two-pole net - - -	4	13s. 4d.	4 0 0
Use of night line - - -	1	10s.	0 10 0
			£198 12 6

11.—(a.) Five. One at 10l. 10s.; one at 5l. 5s.; one at 4l. 4s.; and two at 1l. 1s. (b.) One at 10s. Total 22l. 11s.

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

			£ s. d.	£ s. d.		
Spear in possession -	Carmarthen	3	3 19 0	2 1 0	—	—
No trout licence -	"	2	0 2 0	0 19 0	—	—
Killing young of salmon.	"	1	0 1 6	0 9 0	—	2
Resisting search -	"	1	0 5 0	0 10 0	—	—
Breach of weekly close season.	"	1	0 1 0	0 9 0	—	—
Using light and spear -	"	3	5 17 0	—	—	—
Killing young of salmon.	Llandilo	5	0 16 10	3 5 8	—	—
Killing trout with lime	"	—	—	—	—	3
Refusing access to dam	"	—	—	—	—	3
No trout licence -	"	2	0 7 6	1 5 6	—	—
Using unlicensed instrument.	"	1	1 2 6	0 12 5	—	—
Assaulting bailiff -	"	—	—	—	—	1
Breach of weekly close season.	"	—	—	—	—	2
Using unlicensed instrument.	"	2	2 0 0	0 18 1	—	—
Using light and spear -	"	3	4 14 7	2 0 6	—	—
Using spear -	"	1	1 0 0	0 12 5	—	—
Using gaff -	Llandovery	4	0 8 0	1 12 0	—	—
Using light and spear -	"	1	0 10 0	0 8 0	—	1
Ditto -	"	1	0 2 0	0 8 0	—	—
No trout licence -	"	1	—	0 9 0	—	—
Using spear -	Llanbordy	1	2 10 0	0 10 0	—	1
Using spear or gaff -	"	5	5 4 0	3 0 3	—	1
Unseasonable salmon -	Llanelli	1	0 1 0	1 4 0	—	—
No trout licence -	"	2	0 10 0	1 4 0	—	—
Taking young of salmon.	"	4	1 5 0	2 1 0	—	—
Refusing access to dam	"	2	0 10 0	1 6 0	—	—
Illegal mesh -	"	—	—	—	—	4
Using explosive -	"	1	2 0 0	0 10 0	—	1
Ditto -	"	1	1 0 0	0 18 0	—	—
Using net without licence.	"	2	4 0 0	1 0 0	—	—
Assaulting bailiff -	"	—	—	—	—	1
Using light and spear -	"	1	2 0 0	1 1 0	—	—

SECOND OFFENCE.

Unseasonable salmon -	Carmarthen	1	3 0 0	0 10 0	—	—
Using net in close season.	"	2	8 18 0	1 2 0	—	—
Using night-lines without licence.	Llandovery	1	2 2 0	0 10 0	—	—

THIRD OR SUBSEQUENT OFFENCE.

Using net in close season.	Carmarthen	1	5 0 0	0 11 0	—	—
Using gaff - - -	"	1	5 0 0	0 15 6	—	—

13.—On the Tave there is no poaching of any consequence. On the upper parts of the Towy and Cothi there is a good deal of spearing in the winter. On the Loughor poaching of every description is very prevalent, and the income derived from it is insufficient to maintain an adequate staff of bailiffs on it.

OGMORE.

OGMORE DISTRICT.

1.—(a.), (b.), (c.) Decreased.

7.—Yes.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Baulk, box, crib, cruive, &c. -	1	2 <i>l.</i> 2 <i>s.</i>	£ <i>s.</i> <i>d.</i> 2 2 0
Draft or seine net - - -	1	3 <i>l.</i> 3 <i>s.</i>	3 3 0
Rod and line - - -	3	1 <i>l.</i> 1 <i>s.</i>	3 3 0
Ditto - - -	13	10 <i>s.</i> 6 <i>d.</i>	6 16 6
			£15 4 6

10:—

Rod and line - - -	109	1 <i>s.</i>	£ <i>s.</i> <i>d.</i> 5 9 0
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13.—Yes.

TAFF AND ELY.

TAFF AND ELY DISTRICT.

1.—(a.), (b.), (c.) No appreciable increase or decrease.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Rod and line - - -	9	10 <i>s.</i> 6 <i>d.</i>	£ <i>s.</i> <i>d.</i> 4 14 6

10:—

Rod and line - - -	325	1 <i>s.</i>	£ <i>s.</i> <i>d.</i> 16 5 0
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RHYMNEY.

RHYMNEY DISTRICT.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Draft or seine net - - -	1	3 <i>l.</i>	£ <i>s.</i> <i>d.</i> 3 0 0
Rod and line - - -	1	10 <i>s.</i>	0 10 0
10:—			
Rod and line - - -	104	1 <i>s.</i>	£ <i>s.</i> <i>d.</i> 5 4 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Sale of unseasonable salmon.	Caerphilly	1	£ s. d. 0 10 0	£ s. d. —	—	—
Killing above - -	"	1	0 10 0	—	—	—

USK DISTRICT.

Usk.

1.—(a.) Increased. (b.) Diminished. (c.) Probably about the same.

2.—(b.) With 825 salmon, weighing 6,516 lbs.

3.—Cannot say. The Act cannot fail to have a beneficial effect. The take by some 2,000 rods cannot be ascertained.

4.—The disease in salmon, which had been so destructive in the two previous years, and especially in 1883, disappeared in a great measure about the third week of January 1884; and many fish that had recovered from it were observed. There was a later outbreak in the Monmouthshire portion of the district towards the end of April, but it had become entirely extinct by the end of May. In Breconshire very few cases were observed after April. It is remarkable that throughout the summer, although the water was sluggish and impure, and the salmon in the lower waters were crowded together in the pools, no disease whatever was observed either among salmon or trout. In a very few cases it reappeared about October, but the number of fish which have died from its effects during the past winter has been extremely small.

6.—A fish pass has been constructed near Llangenny Bridge on the Grwyny. It is not yet quite completed.

8.—Under the present law little or nothing can be done.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PRIVATE WATERS.

Putcher - - - -	3,350	30s. for 50.	£ s. d. 100 10 0
Putt - - - -	150	2s. 6d.	18 15 0
Stop net - - - -	7	7l. 10s.	52 10 0
Beating net - - - -	1	20l.	20 0 0
Rod and line - - - -	202	1l.	202 0 0
			£393 15 0

10:—

Rod and line - - - -	1,983	1s.	£ s. d. 99 3 0
Night lines - - - -	9	5s.	2 5 0
			£101 8 0

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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Monmouthshire District (including Crickhowell).

FIRST OFFENCE.

Possession of gaff, &c. -	Abergavenny	1	£ s. d.	£ s. d.	—	—
Taking young of salmon	Usk	1	3 0 0	0 10 6	—	—
			2 0 0	6 16 0		

Brecon District.

FIRST OFFENCE.

Assaulting water bailiff	Defynnock	—	—	—	—	2
Netting without a licence (trout).	"	2	3 0 0	and costs.	—	—
Ditto - - -	Brecon Co.	1	0 2 6	1 6 0	—	—
Night netting (trout) -	Defynnock	2	3 0 0	and costs.	—	—
Possession of gaff, &c. -	"	3	—	0 6 6	—	—
Ditto - - -	"	3	0 2 6	0 7 0	—	—
Possession of unseasonable salmon.	"	2	0 5 0	0 10 9	—	—
Ditto - - -	Brecon Boro'	—	—	—	—	3
Taking the young of salmon.	"	1	—	0 12 6	—	—

SECOND OFFENCE.

Possession of gaff, &c. -	Defynnock	1	2 10 0	0 7 6	—	—
Possession of unseasonable salmon.	Brecon Co.	1	2 10 0	0 13 9	—	—

THIRD OR SUBSEQUENT OFFENCE.

Possession of unseasonable salmon.	Brecon Co.	1	5 0 0	0 15 9	—	—
Ditto - - -	"	1	7 0 0	0 12 6	—	—

The decrease in the number of cases in the Brecon district appears to be solely due to the fact that during the past dry season few fish were able to reach the upper water.

13.—It prevails to a very great extent in the Brecon district. There is now very little illegal fishing in the Monmouthshire district.

WYE.

WYE DISTRICT.

1.—Mr. Miller, lessee of the whole (except a small portion) of the tidal waters within the district, states that the take of salmon in 1884 in the tidal waters and the fresh water (*i.e.*), between Biggs Weir Bridge and Symonds Yat has decreased, while Mr. Stephens, one of the principal lessees of the freshwater fisheries extending from a short distance above Symonds Yat to and above Hereford, states that the take of salmon in 1884 has increased. From the various reports I have from time to time received, I am of opinion that on the whole the take of salmon in 1884 throughout the district has increased.

3.—No. The upper portion of the Wye and tributaries have for many years been systematically netted by poachers at night. It is, however, hoped that the byelaws made by the Board on the 18th October 1884 under the Freshwater Fisheries Act, 1884, will be the means of putting a check to this.

4.—Salmon disease appeared in the fresh waters of the Wye in the early months of the year 1884, but not to the same extent as in the year 1883. It however disappeared after the first floods in May and June.

9:—

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	23	5 <i>l</i> .	£ 115 0 0
Beating net - - -	9	5 <i>l</i> .	45 0 0
Stop net - - -	44	3 <i>l</i> .	132 0 0
Lave net - - -	3	1 <i>l</i> .	3 0 0
Patcher - - -	2,097	1 <i>l</i> . for every 50	42 0 0
Rod and line - - -	19	10 <i>s</i> .	9 10 0
Ditto - - -	152	1 <i>l</i> .	152 0 0
			£248 10 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Using gaff for taking salmon.	Ross	2	£ s. d. 1 0 0	£ s. d. 0 10 0	—	—
Taking young of salmon	"	2	2 0 0	0 11 6	—	—
Aiding and abetting ditto.	"	1	2 0 0	0 11 6	—	—
Fishing for salmon during weekly close season.	Chepstow	3	5 0 0	0 15 4	—	—
Ditto - - -	"	3	3 0 0	0 9 4	—	—
Taking young of salmon	Hereford	4	Three, 10 <i>s</i> ., one, 1 <i>s</i> .	One, 11 <i>s</i> ., one, 1 <i>s</i> ., one, 12 <i>s</i> . 6 <i>d</i> ., one 13 <i>s</i> . 6 <i>d</i> .	—	—

13.—Yes, to some extent. The Conservators are unable to employ a sufficient staff of water bailiffs to put a stop to it, owing to the inadequate income of the Board.

SEVERN DISTRICT.

SEVERN.

1.—(a.), (b.), (c.) Decreased.

2.—20,000 salmon, weighing 265,000 lbs.

4.—Yes. One or two diseased fish were caught. See Report, paragraph 40, which will be sent shortly.*

6.—A new pass has been made in a weir at Newtown, and something has been done at Llanidloes.

Extensive alteration has been made at Lincombe Weir. We believe they have proved successful.

8.—Several prosecutions were instituted, for list of these, see list of prosecutions.

9:—

PUBLIC WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft net - - -	15	3 <i>l</i> .	£ 45 0 0
Ditto - - -	16	2 <i>l</i> .	32 0 0
Ditto - - -	20	1 <i>l</i> . 10 <i>s</i> .	21 0 0
Lave net - - -	90	1 <i>l</i> . 10 <i>s</i> .	135 0 0
Ditto - - -	7	1 <i>l</i> .	7 0 0
			£240 0 0

* NOTE.—The following is the paragraph from the "18th Annual Report of the Board of Conservators of the Severn Fishery District," referred to:—"The salmon disease made its appearance in the spring in the Verniew, though not in a severe form. The disease appeared on the head of the fish, except in one instance, and in that case the fish was badly affected in other parts of the body. No diseased fish have been found dead. One or two fish were also caught near Worcester that were infected with the disease. After May, however, the disease completely disappeared."

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS			
Baulk, box, crib, cruive, &c.	Various. See list annexed.*	—	£ s. d. 212 7 6
Coracle net	1	2l.	2 0 0
Ditto	2	1l. 1s.	2 2 0
Draft net	10	5l.	50 0 0
Ditto	13	4l.	52 0 0
Ditto	6	1l. 1s.	6 0 0
Cross line	1	2l.	2 0 0
Lave net	24	1l. 10s.	36 0 0
Ditto	1	1l.	1 0 0
Ditto	1	15s.	0 15 0
Rod and line	44	10s.	22 0 0
			£386 10 6

10:—

Rod and line	6,941	1s.	£ s. d. 347 1 0
Draft net	51	7s.	17 17 0
Bush net	18	7s.	4 4 0
Cleeching net	1	7s.	0 7 0
Cleeching net	17	5s.	4 5 0
Weir trap	21	15s.	15 15 0
Night line	87	5s.	21 15 0
Other device	1	10s.	0 10 0
			£411 14 0

11.—One at 15l.

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Catching salmon during annual close time.	Llansilin	1	£ s. d. 1 0 0	£ s. d. 0 10 0	—	—
Having a gaff with intent to take salmon.	"	1	0 9 0	0 11 0	—	—
Having unseasonable salmon in possession.	Leominster	1	0 3 6	1 6 6	—	—
Attempting to take salmon with a net of unlawful mesh.	Upton-on-Severn.	2	0 10 0	0 8 0†	—	—
Fishing for trout without a licence.	Worcester	1	0 2 0	0 10 6	—	—
Ditto	"	2	0 2 0	0 9 6	—	—
Taking salmon during weekly close time.	Gloucester	1	{ 6 0 0 Imprisoned	{ 0 7 0 }	—	—
Ditto		1			—	—
Ditto	"	2	2 10 0	0 7 0	—	—
Catching elvers during close time.	"	1	1 0 0	0 7 0	—	—
Catching eels in close time.	Shrewsbury	1	{ 1 0 0 Imprisoned 5s. and costs	{ 0 7 0 }	—	—
Catching trout without licence.	Ledbury	6			—	—
Catching elvers during close time.	Tewkesbury	1	0 1 0	0 9 0	—	—
Ditto	"	1	0 5 0	0 9 0	—	—
Catching trout without licence.	Llanfyllin	2	1 0 0	0 9 0	—	—
Using a gaff for taking salmon.	Newtown	—	—	—	—	1
Using net for trout without licence.	Baschurch	1	0 14 0	1 11 6	—	—
Assaulting water bailiff	"	—	—	—	—	1‡

† Net forfeited in one case.

‡ On payment of 10s.

* NOTE.—No such list was annexed to this return. This entry, though placed under the head of "Baulks," &c. apparently refers to putts and putchers. It appears from the "18th Annual Report" of the Board that 243 putts at 2s. 6d., 180 putts at 1s., 5680 putchers at 1l. per 50, and 16 outriggers at various rates were licensed in 1884.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Taking trout without licence.	Cleobury Mortimer.	4	£ s. d. 1s. and costs	£ s. d. —	—	—
Attempting to take trout without a licence.	Oswestry	1	1 0 0	1 4 0	1	—
Taking fish after sunset.	Dorrington	6	1s. and costs	—	—	—
Putting lime into the river for the purpose of killing trout.	Berriew	2	2 0 0	0 14 0	—	—
Fishing for trout without licence.	Worcester	2	0 2 0	—	—	—
Allowing poisonous liquid to flow into the river so as to kill fish.	Bridgnorth	2	0 5 0	—	—	—
Fishing for trout without a licence.	Broseley	1	0 2 0	0 9 4	—	—
Allowing poisonous liquid to flow into the Roden so as to kill fish.	Wem	1	5s. and costs	—	—	—
Fishing for trout without licence.	Worcester	1	10s. 6d. including costs	—	—	—
Catching trout without licence.	Llanfair	—	—	—	—	1
Using spear for catching trout.	Berriew	1	2s. 6d. and costs	—	—	—
Fishing for trout without licence.	Ludlow	1	2s. and costs	—	—	—
Fishing for salmon during weekly close time.	Thornbury	3	5 0 0	1 3 0	—	—
Fishing for trout without a licence.	Welshpool	—	—	—	2	1
Aiding and abetting ditto.	"	—	—	—	1	—
Selling trout in close time.	Newtown	1	0 10 0	0 10 0	—	—
Fishing for trout without a licence.	Purslow	1	15s. including costs	—	—	—
Having a gaff with intent to take salmon.	Llanfyllin	1	2l. 10s. and costs	—	—	—

13.—The Board decline to answer a question that implies it is not doing its duty.

15.—A grating was removed at Abertanat and a new one substituted by the Canal Company with the sanction of the Inspector without notice to the Board. The Inspector's Assistant has reported that the grating would not prevent the passage of smolts, and it is therefore illegal and ineffectual. The Board have protested against the illegal conduct of the Inspector, but the only result is that he still encourages the Company to violate the law.

AVON, BRUE, AND PARRET DISTRICT.

AVON, BRUE,
AND PARRE

1.—(a.), (b.), (c.). Decreased.

2.—With net, 340 salmon; by putts and putchers, 260 salmon. Total 600, weighing altogether 7,800 lbs.

9 :—

PUBLIC WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Dip net - - - -	38	10s.	£ s. d. 19 0 0
Pitching net - - -	18	1l.	16 0 0
Putcher - - - -	1,292	1l. for 99	13 0 0
			£48 0 0

13.—Much reduced even since last year.

TAW AND
TORRIDGE.

TAW AND TORRIDGE DISTRICT.

1.—(a.), (b.), (c.). Diminished.

The season was an exceptionally dry one. There were no freshets throughout the summer; in fact, there was no heavy water until November. This will principally account for the lessened take of salmon.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Baulk box, crib, cruive, &c. -	1	6l.	£ s. d. 6 0 0
Hang or drift net - - -	9	5l.	45 0 0
Draft or seine net - - -	47	5l.	235 0 0
			286 0 0

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Baulk, box, crib, cruive, &c. -	4	6l.	£ s. d. 24 0 0
Rod and line - - -	187	10s. 6d.	98 3 6
			£122 3 6

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Killing two salmon in close season.	South Molton County Bench.	1	£ s. d. 3 0 0	£ s. d. 0 14 6	—	—
Using unlawful instrument for catching salmon.	"	1	1 0 0	0 14 6	—	—
Killing two unseasonable salmon.	"	1	1 0 0	0 14 6	—	—
Using fixed engine -	"	1	5 0 0	0 14 6	—	—
Using a gaff - - -	"	1	2 0 0	0 11 6	—	—
Ditto - - -	"	1	3 0 0	0 13 6	—	—
Having in possession unseasonable salmon.	Bideford County Bench.	2	3 1 6	1 18 0	—	—
Taking salmon in close time.	Barnstaple County Bench.	4	2 12 6	0 14 4	—	—
Having in possession unseasonable salmon.	"	1	2 12 6	0 11 0	—	—
Taking salmon in close time.	"	1	0 10 0	0 10 6	—	—
Ditto - - -	"	1	0 10 0	0 7 6	—	—
Ditto - - -	"	2	0 10 0	0 7 0	—	—
Obstructing water bailiff.	"	3	0 10 0	0 7 8	—	—
Having in possession unseasonable salmon.	"	1	0 10 0	0 12 0	—	—

13.—Yes.

CAMEL.

CAMEL DISTRICT.

1.—In consequence of the drought during the summer of 1884, many salmon peel were netted in the lower portion of the Camel; and the bright weather and small water interfered with the rod and line fishermen.

3.—I consider the trout fishing has improved, and that, if the proposed byelaw preventing fishing till 15th March is sanctioned, there will be a greater

improvement, and much better trout will be caught. Sir W. W. R. Onslow, Baronet, of Hengar, placed 1,000 young trout in the upper part of the De Lank tributary, which were reared by Mr. Andrews, of Guildford.

6.—The hatch referred to in last year's answers has been built into the side wall of the waterworks leat at Blackpool, and two substantial masonry buttresses have been constructed with thick slate hatches to form the western side of the resting pool, formed to enable the fish to pass the weir in two leaps.

These hatches are fitted with screws for lifting, the arrangements have been quite successful, and the fish have easily passed to the upper waters.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Draft or seine net - - -	7	2l.	£ s. d. 14 0 0
Rod and line - - -	26	10s.	13 0 0
			£27 0 0

10:—

Rod and line - - -	244	3s.	£ s. d. 36 12 0
Ditto (day) - - -	13	1s.	0 18 0
			£37 5 0

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Having in possession a snatch.	Division of Trigg.	2	£ s. d. 1 0 0	£ s. d. 0 10 6	—	—
Taking salmon without license.	"	1	1 0 0	0 9 6	—	—
Fishing with a net within 50 yards of a mill dam.	"	2	0 1 0	1 18 0	—	—
Ditto - - -	"	4	0 1 0	0 13 0	—	—

THIRD OR SUBSEQUENT OFFENCE.

Unlawfully taking trout.	Division of Trigg.	1	0 5 0	0 9 6	—	—
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13.—I believe some illegal fishing has taken place near Camelford, but a conviction was obtained on 12th February 1885, and a summons is pending for having a spear by the river side.

15.—A grating has been fixed near Dunmere Bridge, but it has been damaged by flood, and there is a suspicion that bags or faggots were purposely sent down stream to damage it.

FOWEY.

FOWEY DISTRICT.

1.—(a.), (b.), (c.). Diminished.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Draft or seine net - - -	12	2l. 10s.	£ s. d. 30 0 0
Rod and line - - -	25	10s.	12 10 0
			£42 10 0

10:—

Rod and line - - -	*646	3s.	£ s. d. 96 18 0
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* Of this number 39 were issued in 1883, but were not returned by the agents until this year.

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Attempting to take trout without licence.	West Kirrier	—	—	—	—	2
Taking a trout without licence.	"	1	1s.	8s. 6d.	—	—
Having unseasonable salmon in possession.	Tywardreath, Powder.	2	10s. and costs.	—	—	—

TAMAR AND
PLYM.

TAMAR AND PLYM DISTRICT.

1.—In the Tavy River the take of salmon by net was in excess of anything known for years. (a.) Decreased. (b.) Decreased, except in Tavy, where the take has increased. (c.) Decreased.

7.—No. But the Paper Mills at Lee Mills on the Yealm are at work, and from which substances poisonous to fish are said to flow into the river at times.

8.—An inspection has been made by Mr. Fryer of the weirs, &c. within the district, and a report furnished thereon to the Board.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PUBLIC WATERS.			
Coracle net - - -	1	—	£ s. d. 1 10 0
PRIVATE WATERS.			
Draft or seine net - - -	4	3l. 10s.	£ s. d. 14 0 0
Rod and line - - -	279	7s. 6d.	104 12 6
			£118 12 6

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Illegal taking of salmon.	Tavistock	1	£ s. d. 5 0 0	£ s. d. 0 18 0	—	—
Ditto - - -	Ditto	1	1 0 0	0 8 6	—	—

AVON AND ERME DISTRICT.

AVON AND
ERME.

1.—(a.), (b.), (c.) In the Avon and Erme the take has diminished, it having been so dry a season they have not had opportunities of entering both rivers.

2.—(a.) In the Erme 6 salmon and 964 migratory trout. (b.) In the Avon,* 110 salmon, weighing 1,320 lbs., and 100 migratory trout weighing 100 lbs.

7.—No. But there has been no abatement in the pollution of the Avon at South Brent, and the Erme at Ivybridge, and the pollutions in both rivers remain in the same state as previously reported.

8.—Three samples of water from the Erme taken at the different parts of the river at Ivybridge have been sent to the Inspector of Fisheries, and analysed by Dr. Percy F. Frankland, F.C.S., but owing to some discrepancy in the analysis, it has been determined to send him fresh samples to analyse. Notices have also been given to millowners on the Erme to keep their mill sluices down on Sundays.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Baulk, box, crib, cruipe, &c. -	1	5s.	£ s. d. 5 0 0
Draft or seine net - - -	4	5s.	20 0 0
Hand net - - -	1	1s.	1 0 0
Rod and line - - -	27	1s.	27 0 0
			£53 0 0

10:—

Rod and line (season) - -	55	10s.	£ s. d. 27 10 0
Ditto (day) - - -	297	1s.	14 17 0
			£12 7 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Taking an unseasonable salmon.	Kingsbridge	1	£ s. d. 5 0 0	£ s. d. 0 8 0	—	—
Aiding and abetting above.	Ditto	1	3 0 0	0 8 0	—	—
Disturbing salmon -	Totnes Bench	1	5 0 0	1 4 8	—	—
Unlawfully attempting to catch salmon.	Ditto	—	—	—	—	1 †
Unlawfully catching salmon.	Ditto	—	—	—	—	1

13.—Yes, it is prevalent in the Avon, but not in the Erme.

* Cannot ascertain what has been caught by net licensees in the Avon.

† On payment of costs.

DART.

DART DISTRICT.

1.—(a.), (b.), (c.). Diminished.

2.—An exceptional season. No means of forming an estimate.

In the early part of the season the numbers were fairly plentiful up to the end of May, but on the dry weather then setting in, which continued up to the end of the season and later, no fish entered the river, and the season on the whole was a very bad one.

3.—Certainly increased.

The close season beginning in October has, however, been the cause of the greatest benefit towards the increase.

The numbers taken in 1884 were much below the average consequent on the dry season, with very little water in the river.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	19	5l.	£ s. d. 96 0 0
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PRIVATE WATERS.

Draft or seine net - - -	2	5l.	£ s. d. 10 0 0
Rod and line (season) - - -	45	1l.	45 0 0
Ditto (one week) - - -	21	7s. 6d.	7 17 6
			£62 17 6

10:—

Rod and line (season) - - -	188	10s.	£ s. d. 94 0 0
Ditto (one day) - - -	136	2s.	13 12 0
			£107 12 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Taking trout without licence.	Totnes	1	15s. 6d. to include costs.	—	—	—

13.—Only to a slight extent.

TEIGN.

TEIGN DISTRICT.

1.—(a.) Greatly increased. (b.) Slightly diminished. (c.) Increased.

2.—(a.) 1,000 salmon, weighing 7,000 lbs. (b.) 20 salmon, weighing 160 lbs.; 300 migratory trout, weighing 450 lbs. Total 610 lbs.

3.—Yes. No record has been kept of the number taken.

8.—Notice was served on a person who proposed to wash over some poisonous mine soil requiring him to desist. No pollution has taken place since the notice.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	13	3 <i>l.</i> 10 <i>s.</i>	£ <i>s.</i> <i>d.</i> 45 10 0
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PRIVATE WATERS.

Rod and line - - -	35	1 <i>l.</i>	£ <i>s.</i> <i>d.</i> 35 0 0
Ditto - - -	20	2 <i>s.</i>	2 0 0
			£37 0 0

10:—

Rod and line - - -	355	2 <i>s.</i> 6 <i>d.</i>	£ <i>s.</i> <i>d.</i> 44 7 6
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12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Attempting to take salmon with a small mesh net.	Teignmouth	4	5 <i>s.</i> each and costs 18 <i>s.</i> 4 <i>d.</i>	—	—	—
For taking salmon in the annual close season.	"	2	2 <i>l.</i> each and costs.	—	—	—
Attempting to take salmon with a small mesh net.	"	2	Pleaded guilty. No fine, only costs 18 <i>s.</i>	—	—	—

EXE DISTRICT.

Exe.

1.—(a.), (b.), (c.) Not increased in number, but fish of a larger size.

2.—With rod, 250 to 280 salmon, weighing 2,200 lbs.

6.—No new passes erected, but diagonal baulks placed on five weirs, three of which have been washed away. It is thought that these baulks, had they all withstood a sudden flood, would have materially assisted fish in their ascent to the upper waters.

7.—No new deleterious substances have gone into the river, but in consequence of the very low condition of the water for a long period, and its high temperature, fish of all descriptions, including salmon, died from the unhealthy state of the river, especially about the city of Exeter, the sewage matter of which goes into the Exe.

9:—

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	40	3 <i>l.</i> 10 <i>s.</i>	£ <i>s.</i> <i>d.</i> 140 0 0
Rod and line - - -	76	1 <i>l.</i>	76 0 0
			£216 0 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Catching fish in close season.	Dulverton	1	£ s. d. 1 0 0	£ s. d. —	—	—
Ditto - - -	Wonford	6	10s. each and costs.*	—	—	—
Fishing without a licence.	"	5	3l. 10s. and costs.*	—	—	—
Ditto - - -	"	3	7l. 10s. and costs.*	—	—	1
Putting poisonous substance into the Exe to kill fish.	Tiverton	2	2 0 0	—	—	1

* Although several applications have been made to the clerk of the magistrates of the Wonford Division for the above fines, they have not yet been received.

13.—It cannot be said to be prevalent, but a certain amount took place.

OTTER.

OTTER DISTRICT.

1.—Salmon have been plentiful in the lower part of the River Otter so far as Otterton Weir, three miles from the mouth of the River Otter; salmon can proceed no further.

4.—No salmon or trout disease has ever appeared in the River Otter, hence the river should be open during close time all through the river. The River Otter is capable of producing innumerable fry if allowed to be all open during close time. Otterton Weir is the only obstacle I know of.

13.—Yes. The police say they would easily stop the same, but no one takes any interest, except Lady Rolle, and that part is only six miles from the mouth.

AXE.

AXE DISTRICT.

1.—(a.) Increased. (b.) Increased, but in less degree. (c.) Generally increased.

2.—30 salmon, weighing 240 lbs.; migratory trout, 2,960 lbs. Total, 3,200 lbs. (b.) 20 migratory trout, weighing 70 lbs.

3.—Believe these fish have decreased in number, but not in consequence of the Freshwater Fisheries Act of 1878.

4.—Quantities of dead salmon were seen lying in different parts of the Axe, in the lower part within three miles of the sea, and also in tidal waters, but floods carried them off before they could be secured for inspection.

5.—Westwater Weir has been repaired.

8.—As a new system of drainage has been carried out by the Seaton Local Board, it is hoped that no sewage from that town or from the Seaton Railway Station will continue to enter the River Axe.

9:—

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	4	5l.	£ s. d. 20 0 0
Rod and line - - -	5	1l.	5 0 0
			£25 0 0

12 :—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Unlawfully fishing for salmon.	Axminster	1	£ s. d. 1 0 0	£ s. d. 0 11 0	—	—
Ditto - - -	„	1	1 0 0	0 13 0	2	—

SECOND OFFENCE.

Illegally fishing for salmon in private waters.	Axminster	1	0 3 0	1 2 0	—	3
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13. — Yes; but not to any great extent.

FROME DISTRICT.

FROME.

9 :—

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	1	5l.	£ s. d. 5 0 0
Rod and line - - -	1	1l.	1 0 0
			£8 0 0

AVON AND STOUR DISTRICT.

AVON AND STOUR.

- 1.—(a.), (b.), (c.). Decreased as compared with 1883.
 2.—(a.) With net, 1,294 salmon. (b.) With rod, 221. Total 1,515.
 4.—It has appeared lately only (21st January 1885) in the River Stour. 23 dead salmon having the fungus disease were taken from the River Stour in January 1885.

9 :—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	26	3l.	£ s. d. 78 0 0
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PRIVATE WATERS.

Draft or seine net - - -	7	3l.	£ s. d. 21 0 0
Fishing weir - - -	2	5l. and 12l.	17 0 0
Rod and line - - -	83	1l.	83 0 0
			£121 0 0

13.—It is believed in the upper districts.

15.—A new grating was placed in Sopley Mill Head Race. It is effective. A grating is being placed in the Ringwood Mill Tail Race at a place called the Hampshire Hatches.

OUSE.

OUSE (SUSSEX) DISTRICT.

3.—Increased.

9:—

PUBLIC WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Haaf or heave net - -	1	—	£ s. d. 2 5 0

ROTHER.

ROTHER DISTRICT.

1.—Stationary.

STOUR (KENT) DISTRICT.

STOUR.

1, 2.—The cultivation of salmon and migratory trout in this river has been abandoned for many years.

3.—There is a fine stock of trout in the preserved part of the river, and the fish are now (1st January 1885) very busy in the spawning beds. There is no positive record of the number of trout taken, but sport has been good during the past season.

13.—Poaching is rendered somewhat difficult in the preserved portion of the river.

TRENT DISTRICT.

TRENT.

1.—(a.), (b.), (c.). Increased.

2.—(a.) 2,700 salmon, weighing 27,000 lbs.; (b.), say 450 salmon, weighing 5,400 lbs.

3.—Yes. It is believed in a great measure to be the result of artificial propagation. Not so many were taken as in previous years, owing to the low state of the rivers in the season. It is presumed that, owing to the same reason, more have been taken illegally.

5.—No. The boards on the top of the weir at Tutbury, used to back up the water, were removed whilst the salmon were ascending.

7.—Yes. One factory on the Ecclesbourne, a tributary of the Derwent.

8.—Pressure as far as practicable has been put upon parties offending, but with little result.

The need for removing the nuisance of the sewage from the Burton Breweries has been made more apparent than ever this year owing to the great drought.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Draft or seine net - - -	13	5l.	£ s. d. 65 10 0
Stand net - - -	10	1l.	10 0 0
Rod and line - - -	213	10s.	106 10 0
			£181 10 0

10:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Rod and line - - -	3,431	1s.	£ s. d. 171 11 0
Net - - -	80	5s.	20 0 0
			£191 11 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Taking trout in the close time.	Leek	1	5s. and costs.	—	—	—
Ditto - - -	"	1	1s. and costs.	—	—	2
Ditto - - -	Bakewell	1	1l. and costs.	—	—	—
Having unseasonable salmon in possession.	Leicester	1	9s. 6d. including costs.	—	—	—
Ditto - - -	Lough-borough.	3	5s. each and costs.	—	—	2
Fishing for trout without a licence.	Uttoxeter	—	—	—	—	3
Fishing for freshwater fish in close time.	Derby	1	1l. 11s. and costs.	—	—	—
Fishing for trout without a licence.	Lough-borough.	2	2l. 15s. 9d. each and 1l. 4s. 3d. costs.	—	—	—
Exposing freshwater fish for sale during the close time.	Nottingham	2	10s. each including costs.	—	—	—
Taking trout illegally -	Chapel-en-le-Frith.	1	5l. and costs.	—	—	—
Fishing for salmon without a licence.	Newark	1	1l. and costs.	—	—	—
Fishing for freshwater fish in the close time.	Nottingham	1	2s. 6d. and costs.	—	—	—
Taking trout without a licence.	Ashborne	1	1s. and costs.	—	—	—
Attempting to take freshwater fish in the close time.	Southwell	1	2l. including costs.	—	—	1
Night netting contrary to byelaw.	Buxton	1	1l. and costs.	—	—	—
Attempting to take trout without a licence.	Belper	1	1l. and costs.	—	—	—
Night netting - - -	Derby	2	2l. each and costs.	—	—	—

13.—Yes, illegal fishing is carried on to a large extent, although by the action of this Board it has been lessened considerably.

YORKSHIRE DISTRICT.

YORKSHIRE.

1.—(c.) Greatly diminished.

2.—(a.) 3,237 salmon, weighing 38,145 lbs., and 794 migratory trout, weighing 3,501 lbs. Total 4,031, weighing 41,646 lbs.

4.—There has been slight indication of the "salmon disease," but the Board has not any reliable information.

6.—One has been erected at Addingham on the River Wharfe. It is believed to be successful, as trout pass up it.

9:—

PUBLIC WATERS.

Name of instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	4	2l. 10s.	£ 8 0 0
Ditto - - - - -	2	5s.	10 0 0
Ditto - - - - -	2	3l. 10s.	7 0 0
Ditto - - - - -	1	3l. 15s.	3 15 0
Bow net - - - - -	2	1l.	2 0 0
			£32 15 0

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
PRIVATE WATERS.			
Draft or seine net - - -	4	7 <i>l</i> .	£ s. d. 28 0 0
Ditto - - - - -	37	5 <i>l</i> .	185 0 0
Lave net - - - - -	14	5 <i>l</i> .	70 0 0
Ditto - - - - -	23	2 <i>l</i> .	44 0 0
Rod and line - - -	17	1 <i>l</i> .	17 0 0
			£344 0 0

10:—

Draft net - - - - -	8	1 <i>l</i> . 13 <i>s</i> . 4 <i>d</i> .	£ s. d. 13 6 8
Night line - - - - -	1	1 <i>l</i> .	1 0 0
			£14 6 8

11.--(a.) One at 2*l*.

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Using a net without a licence.	Goole	—	£ s. d. —	£ s. d. —	1	—
Ditto - - - - -	Wetherby	1	10 0 0	—	—	—
Fishing during weekly close season.	Selby	—	1 0 0	0 11 0	—	—
Ditto - - - - -	Goole	4	2 0 0	0 9 0	—	—
Ditto - - - - -	"	8	2 0 0	0 9 0	—	—
Ditto - - - - -	"	2	3 0 0	0 9 0	—	—
Ditto - - - - -	"	1	5 0 0	0 9 0	—	—
Ditto - - - - -	"	1	Two months imprisonment.	—	—	—
Snatching trout -	Pickering	—	—	—	—	5
Ditto - - - - -	"	2	0 10 0	0 10 6	—	—
Fishing during weekly close season.	Goole	1	2 0 0	0 7 0	—	—
Ditto - - - - -	"	1	4 0 0	1 0 0	—	—
Using illegal instruments.	"	1	0 10 0	0 12 0	—	—
Fishing during weekly close season.	"	—	—	—	—	1
Using unlawful instruments.	Snaith	1	0 5 6	0 14 6	—	—
Fishing during weekly close season.	Howden	1	0 10 0	0 9 0	—	—
Ditto - - - - -	Snaith	—	—	—	—	1

13.—There is more or less in the higher tributaries and the remoter mountain streams.

Esk.

ESK (YORKSHIRE) DISTRICT.

1.—(a.) Increased. (b.) Diminished. (c.) Increased.

2.—(a.) 5,833 salmon. (b.) 107 salmon.

4.—Yes, but to a very trifling extent.

9:—

PUBLIC WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Hang or drift net - - -	22	2 <i>l</i> . 10 <i>s</i> .	£ s. d. 55 0 0

PRIVATE WATERS.

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
Draft or seine net - - -	2	2l.	£ s. d. 4 0 0
Rod and line - - -	48	10s.	21 0 0
Ditto - - -	18	5s.	4 10 0
Ditto - - -	5	2s. 6d.	0 12 6
			£30 2 6

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Taking salmon in close time.	Division of Whitby Strand.	1	£ s. d. 1 4 0	£ s. d. 0 16 0	1	—
Ditto - - -	"	2	3 0 0	1 0 0	—	—

TEES DISTRICT.

TEES.

1.—(a.) Increased. (b.) Decreased. (c.) Increased.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Hang or drift net - - -	28	5l.	£ s. d. 130 0 0
Ditto - - -	1	5l. 10s.	5 10 0
Ditto - - -	3	6l.	18 0 0
Ditto - - -	5	6l. 10s.	32 10 0
Ditto - - -	5	7l.	35 0 0
Ditto - - -	11	7l. 10s.	82 10 0
			£303 10 0

PRIVATE WATERS.

Hang or drift net - - -	19	5l.	£ s. d. 95 0 0
Rod and line - - -	74	1l. 5s.	92 10 0
			£187 10 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Killing salmon in close time.	Greta Bridge	1	£ s. d. 7 0 0	£ s. d. 0 7 6	—	—
Fishing without licence	"	1	3 0 0	0 7 6	—	—
Killing salmon with illegal instrument.	"	1	2 0 0	0 8 6	—	—
Ditto - - -	"	1	2 0 0	—	—	—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Killing salmon in close time.	Greta Bridge	3	£ s. d. 0 15 0	£ s. d. 0 17 0	—	—
Ditto - - -	"	2	5s. each, and 10s. each for every fish (22 in number).	—	—	—
Ditto - - -	Darlington	1	1 0 0	—	—	—
Fishing without licence	"	1	2s. 6d., and 10s. for the fish.	—	—	—
Killing salmon in close time.	Stockton	1	2s., and 1s. for every fish (four in number), and 1l. 5s. 10d. costs.	—	—	—
Refusing to allow boat to be searched.	"	1	0 8 0	0 12 0	—	—

WEAR.

WEAR DISTRICT.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	7	5s.	£ s. d. 35 0 0
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PRIVATE WATERS.

Rod and line - - -	77	5s.	£ s. d. 19 5 0
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10:—

Rod and line - - -	1,442	1s.	£ s. d. 72 2 0
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12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Fishing with a fixed engine.	South Shields	3	£ s. d. 2 10 0	£ s. d. —	—	—
Catching salmon in a mill race.	Bishop Auckland.	4	1 11 0	0 9 0	—	—
Attempting to kill salmon in the tail race of a mill.	"	1	1 0 0	0 8 0	—	—
Ditto - - -	"	1	0 10 0	0 8 0	—	—
Ditto - - -	"	1	0 5 0	0 8 0	—	—
Fishing without a licence.	Durham	1	0 5 0	0 8 0	—	—

13.—Only to a limited extent.

TYNE DISTRICT.

TYNE.

1.—(a.), (b.), (c.) Decreased. Salmon decreased from 32,566 in 1883 to 21,286 in 1884. Migratory trout decreased from 18,887 in 1883 to 13,140 in 1884.

2:—

Salmon.		Trout (migratory).		Total.	
No.	lbs.	No.	lbs.	No.	lbs.
(a) 20,902	293,838	12,846	38,838	33,838	332,426
(b) 294	4,116	294	832	588	4,996
21,286	298,094	13,140	39,620	34,426	337,424

3.—Cannot give any idea whether they have increased or diminished since the Fresh Water Fisheries Act came into operation in this district. This dry season by drying up the small runners has destroyed all the young fish.

4.—The Chairman of this Board states: "I observed several cases of salmon disease, and several were reported to me, after the dry weather set in (March 16). I am inclined to think all the 'spring run' of fish died after the 6th April, and few, or no fish came up the river above tide-way for any distance till October. No disease was seen in late run fish."

7.—There have been no new mines or factories opened in this district in 1884, but a great quantity of poisonous substances still continues to flow into the river from the tar and chemical factories, and owing to the very small scour in the river for want of water many pollutions, which in a normal state of the river were comparatively harmless, have this year been destructive. A number of dead salmon have been found by the water bailiffs in the tideway where the pollutions exist.

8.—No steps have been taken. The present anti-pollution Act is unworkable. Remonstrances have been made without effect, except in the case of the Newcastle and Gateshead Gas Company, and the Tar Products Company at Redhough, both of whom stopped causes of pollution at the Chairman's request.

9:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Drift or seine net - - -	107	5 <i>l.</i> for 600 yards and 6 <i>d.</i> per yard above 600.	£ s. d. 535 0 3
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PRIVATE WATERS.

Drift or seine net - - -	53	5 <i>l.</i>	£ s. d. 263 0 0
Rod and line - - -	133	1 <i>l.</i>	136 0 0
Ditto - - -	126	10 <i>s.</i>	62 10 0
Ditto - - -	36	7 <i>s.</i> 6 <i>d.</i>	13 10 0
			£474 13 0

10:—

Rod and line (season) - -	821	2 <i>s.</i> 6 <i>d.</i>	£ s. d. 102 12 6
Ditto (month) - -	414	1 <i>s.</i>	20 14 0
			£123 6 6

11.—(a.) Nineteen at various rates, realizing 61*l.* 10*s.* 0*d.* (b.) One at 2*l.*
Total 63*l.* 10*s.* 0*d.*

12:—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
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FIRST OFFENCE.

Killing a salmon without a licence.	Bellingham	1	£ s. d. 1 0 0	£ s. d. 0 12 6	—	—
Attempting to kill salmon with a gaff.	"	1	0 10 0	1 0 0	—	—
Killing salmon in annual close time.	"	1	0 10 0	0 16 3	—	—
Killing trout in close time.	Haltwhistle	1	0 5 0	1 1 0	—	—
In possession of salmon roe.	"	1	0 10 0	1 4 6	—	—
In possession of unseasonable salmon.	Bellingham	1	1 10 0	1 10 6	1	—
Attempting to kill salmon in close time.	"	—	—	—	—	2
Fishing without licence	Hexham	1	0 10 0	1 3 0	—	—
Ditto - - -	"	1	0 1 0	1 5 3	—	—
Ditto - - -	Bellingham	3	0 2 2	0 17 10	—	—
Killing salmon smolts.	"	—	—	—	—	1
Fishing in playground	South Shields	1	0 10 0	0 6 0	—	—
Ditto - - -	"	1	0 19 0	0 6 0	—	—
Ditto - - -	"	1	1 0 0	0 6 0	—	—
Ditto - - -	"	1	2 1 6	0 6 6	—	—
Ditto - - -	"	1	0 4 9	0 9 0	—	—
Ditto - - -	"	1	0 15 0	0 6 0	—	—
Ditto - - -	"	1	0 9 6	0 6 4	—	—
Ditto - - -	"	3	0 4 9	0 6 0	—	2
Fishing in weekly close time.	"	1	2 10 0	0 7 9	—	—
Fishing with an illegal net.	"	2	0 19 0	0 19 3	—	—
Fishing without a licence.	Hexham	2	0 2 6	0 14 0	—	—
Ditto - - -	Moot Hall	1	0 5 0	0 17 10	—	2
Ditto - - -	Haltwhistle	2	0 1 0	0 16 3	—	—
Ditto - - -	Tynemouth	—	—	—	3	—
Fishing with a fixed engine.	"	1	1 0 0	0 19 0	—	1
Ditto - - -	"	—	2 0 0	0 14 10	—	—
Ditto - - -	"	—	1 0 0	0 14 10	—	—
Ditto - - -	"	—	0 10 0	0 14 10	—	—
Ditto - - -	"	2	1 0 0	0 17 6	—	—
Fishing in annual close time.	"	3	0 10 0	0 17 2	—	—

SECOND OFFENCE.

Fishing in playground	South Shields	2	2 0 9	0 6 0	—	—
Ditto - - -	"	2	2 0 9	0 7 9	—	—
Ditto - - -	"	1	0 9 6	0 6 4	—	—
Ditto - - -	"	1	2 10 0	0 6 4	—	—
Ditto - - -	"	1	2 10 0	0 7 0	—	—
Ditto - - -	"	1	0 10 0	0 7 0	—	—
Fishing without a licence.	"	1	10 0 0	0 7 9	—	—
Ditto - - -	Bellingham	—	—	—	—	1

THIRD OR SUBSEQUENT OFFENCE.

Fishing in playground	South Shields	3	4 10 1	0 5 2	—	—
Ditto - - -	"	3	4 10 1	0 6 0	—	—
Ditto - - -	"	4	4 10 1	0 7 0	—	—
Ditto - - -	"	1	2 10 0	0 7 9	—	—
Ditto - - -	"	1	1 0 0	0 7 9	—	—
Aiding and abetting in fishing in playground	"	2	5 0 0	1 19 0	—	1
Fishing in weekly close time.	"	1	2 10 0	0 7 9	—	—
Fishing without a licence.	"	1	10 0 0	0 7 9	—	—

13.—A great amount of illegal fishing takes place in the playground yearly. 29 persons have been detected by the water bailiffs fishing in the playground during the present year, against 21 in 1883, and 17 in 1882. Those persons principally reside in South Shields, and are noted salmon poachers. The law is quite inadequate to meet this class of poaching, and is most unfair to the honest fishermen who observe the law.

COQUET DISTRICT.

Coquet.

1.—(a.), (b.), (c). The number has decreased as compared with last year.

11:—

Name of Instrument.	Number licensed.	Rate at which licensed.	Amount of licence duty received.
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PUBLIC WATERS.

Draft or seine net - - -	34	4 <i>l</i> .	£ s. d. 136 0 0
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PRIVATE WATERS.

Baulk, box, crib, cruive, &c. -	1	12 <i>l</i> .	£ s. d. 12 0 0
Draft or seine net - - -	34	1 <i>l</i> .	34 0 0
Ditto - - -	2	4 <i>l</i> .	8 0 0
Rod and line - - -	383	5 <i>s</i> .	95 15 0
			£149 15 0

12:—

FIRST OFFENCE.

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted.
Having in possession unclean salmon.	Alnwick	1	£ s. d. 0 2 6	£ s. d. 0 14 0	—	—
Ditto - - -	"	1	0 15 0	0 14 0	—	—
Killing young of salmon	"	1	0 1 0	0 13 0	—	—
Fishing with salmon roe.	"	1	1 0 0	including costs.	—	—
Using a fixed engine -	"	1	0 6 6	0 13 6	2	—
Not keeping sluices shut.	"	1	0 5 0	0 13 0	—	—
Fishing during close season.	Morpeth	4	5 0 0	each including costs.	—	—
Disturbing salmon on spawning bed.	Rothbury	1	0 2 6	0 11 6	—	1
Using a gaff - - -	"	—	—	—	—	1
Fishing during close season.	Alnwick	1	1 10 6	0 9 6	—	—
Ditto - - -	"	1	1 17 0	0 13 0	—	—
Having in possession unclean salmon.	Rothbury	1	1 0 0	0 10 6	—	—

Nature of Offence.	Name of Bench before which case was tried.	No. of Defendants convicted.	Penalty on Conviction.	Costs on Conviction.	No. of Defendants against whom Charge was withdrawn.	No. of Defendants acquitted
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SECOND OFFENCE.

Fishing during close season.	Alnwick	1	3 0 0	0 13 0	—	—
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THIRD OR SUBSEQUENT OFFENCE.

Having in possession unclean salmon.	Alnwick	1	4 6 0	0 14 0	—	—
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13.—Yes.

TABLE No. I.—COMPARATIVE RETURN OF THE TOTAL AMOUNT & TOTAL VALUE OF SALMON IN ENGLAND AND WALES IN THE YEARS 1883-84.

District	1883.						1884.						District.
	Nets, &c.		Rods.		General Licences.		Nets, &c.		Rods.		General Licences.		
	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.	
Eden.	171	£ 439 10 0	332	£ 192 15 0	3	£ 43 7 0	183	£ 451 7 6	306	£ 231 15 0	3	£ 43 7 0	Eden.
Derwent.	5	21 0 0	205	145 5 0	2	11 0 0	12	15 0 0	250	179 10 0	3	20 0 0	Derwent.
West Cumberland.	13	45 0 0	320	148 17 6	2	30 0 0	13	49 0 0	268	127 2 6	3	27 0 0	West Cumberland.
Kent.	13	75 0 0	186	98 10 0	—	—	17	95 0 0	166	63 10 0	—	—	Kent.
Lune.	72	248 10 0	70	59 0 0	5	30 0 0	83	235 0 0	81	68 15 0	6	27 0 0	Lune.
Ribble.	23	106 0 0	184	184 0 0	—	—	44	335 10 0	211	211 0 0	2	1 0 0	Ribble.
Dee.	89	441 0 0	105	90 15 0	—	—	107	528 15 0	61	56 0 0	—	—	Dee.
Clewyd and Elwy.	8	28 0 0	46	46 0 0	—	—	13	45 10 0	51	51 0 0	—	—	Clewyd and Elwy.
Conway.	10	27 0 0	235	46 0 0	—	—	10	27 0 0	134	23 17 0	—	—	Conway.
Selton.	8	40 0 0	38	34 5 0	—	—	8	45 0 0	46	39 7 0	—	—	Selton.
Dwyfach.	4	20 0 0	38	34 5 0	—	—	8	45 0 0	46	39 7 0	—	—	Dwyfach.
Dovey.	13	67 0 0	287	165 5 0	—	—	13	67 0 0	287	141 5 0	—	—	Dovey.
Avron.	1	5 0 0	33	22 5 0	—	—	27	15 0 0	37	24 0 0	—	—	Avron.
Telfy.	57	183 5 0	81	62 10 6	—	—	56	183 15 0	84	64 6 0	—	—	Telfy.
Cledydd.	22	37 14 0	39	20 9 6	—	—	27	44 17 0	38	19 19 0	—	—	Cledydd.
Towy.	112	262 3 0	208	318 8 0	3	14 14 0	132	273 0 0	173	181 13 0	—	—	Towy.
Ogmore.	2	5 5 0	19	14 3 6	—	—	19	15 5 0	16	9 19 6	—	—	Ogmore.
Taff and Ely.	—	—	9	4 14 6	—	—	3	5 5 0	9	4 14 6	—	—	Taff and Ely.
Rhymney.	—	—	1	0 10 0	—	—	1	3 0 0	1	0 10 0	—	—	Rhymney.
Uk.	3,650	238 5 0	265	905 0 0	—	—	1,208	191 15 0	262	202 0 0	—	—	Uk.
Wye.	2,174	829 0 0	166	153 0 0	—	—	493	337 0 0	171	161 10 0	—	—	Wye.
Severn.	5,987	574 19 6	31	15 10 0	1	15 0 0	63,938*	604 10 6	44	23 0 0	1	15 0 0	Severn.
Avon, Brue, &c.	1,145	269 0 0	234	122 17 0	—	—	1,346	43 0 0	—	—	—	—	Avon, Brue, &c.
Taw and Torridge.	7	14 0 0	26	13 0 0	—	—	61	310 0 0	187	98 3 6	—	—	Taw and Torridge.
Camel.	10	25 0 0	55	27 10 0	—	—	12	14 0 0	25	13 0 0	—	—	Camel.
Fowey.	3	10 10 0	279	104 12 6	—	—	15	15 0 0	279	164 19 6	—	—	Fowey.
Tamar and Plym.	6	26 0 0	31	31 0 0	—	—	6	28 0 0	67	52 17 0	—	—	Tamar and Plym.
Avon and Ernie.	19	95 0 0	80	65 0 0	—	—	21	105 0 0	66	52 17 0	—	—	Avon and Ernie.
Dart.	3	15 0 0	43	29 10 0	—	—	13	45 10 0	55	37 0 0	—	—	Dart.
Teign.	30	105 0 0	68	68 0 0	—	—	40	140 0 0	76	76 0 0	—	—	Teign.
Exe.	—	—	—	—	—	—	—	—	—	—	—	—	Exe.
Otter.	—	—	—	—	—	—	—	—	—	—	—	—	Otter.
Aze.	4	20 0 0	5	5 0 0	—	—	4	20 0 0	5	5 0 0	—	—	Aze.
Frome.	1	5 0 0	3	3 0 0	—	—	85	116 0 0	88	83 0 0	—	—	Frome.
Avon and Stour.	33	107 0 0	92	92 0 0	—	—	1	5 0 0	—	—	—	—	Avon and Stour.
Ouse (Sussex).	—	—	—	—	—	—	—	—	—	—	—	—	Ouse (Sussex).
Rothe.	—	—	—	—	—	—	—	—	—	—	—	—	Rothe.
Stour.	19	59 0 0	101	50 10 0	—	—	23	75 0 0	213	106 10 0	—	—	Stour.
Trent.	61	250 15 0	21	21 0 0	—	—	88	359 15 0	17	17 0 0	1	2 0	Trent.
Yorkshire.	25	61 0 0	92	53 15 0	—	—	24	59 0 0	65	26 2 6	—	—	Yorkshire.
Essex.	67	384 10 0	91	113 15 0	—	—	70	388 10 0	74	92 10 0	—	—	Essex.
Tees.	6	30 0 0	76	19 0 0	—	—	7	35 0 0	77	19 5 0	—	—	Tees.
Wear.	157	785 0 0	231	191 15 0	—	—	160	800 0 0	294	209 0 0	19	61 10 0	Wear.
Tyne.	59	160 0 0	586	96 10 0	—	—	71	190 0 0	382	95 15 0	—	—	Tyne.
Coquet.	—	—	—	—	—	—	—	—	—	—	—	—	Coquet.
Total.	14,112	5,608 6 6	4,539	3,069 1 0	40	250 11 0	12,710	6,237 5 0	4,571	2,976 2 6	43	252 8 0	Total.

* Not furnished in official return. Taken from "Annual Report" of the Board. See note, p. 74.

TABLE No. II.—COMPARATIVE RETURN showing the NUMBER of LICENCES issued for TROUT and CHAR, exclusive of SALMON, issued during 1883-84 under the provisions of the Freshwater Fisheries Act, 1878, and the REVENUE therefrom.

District.	1883.						1884.					
	Nets, &c.		Rods.		General Licences.		Nets, &c.		Rods.		General Licences.	
	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.	No.	Amount.
Eden.	24	£ 19 5 0	1,379	£ 163 2 0	—	£ s. d. —	21	£ 16 15 0	1,439	£ 171 2 0	—	£ s. d. —
Derwent.	—	—	550	113 0 0	—	—	2	3 6 8	450	99 0 0	—	—
Kent.	97	50 13 4	1,397	174 12 6	—	—	91	45 1 8	1,369	169 17 6	—	—
Seint.	—	—	580	107 14 0	—	—	—	—	454	93 4 0	—	—
Ayrton.	—	—	—	—	—	—	—	—	55	7 3 0	—	—
Teify.	—	—	586	73 5 0	—	—	—	—	614	76 15 0	—	—
Cleddy.	—	—	171	29 18 6	—	—	—	—	161	27 8 0	—	—
Towy.	1	0 10 0	1,579	197 7 6	1	0 5 0	6	9 10 0	1,433	179 2 6	1	0 10 0
Ogmere.	—	—	113	5 12 0	—	—	—	—	109	5 9 0	—	—
Taff and Ely.	—	—	340	17 0 0	—	—	—	—	325	16 5 0	—	—
Rhyrney.	—	—	122	6 2 0	—	—	—	—	104	5 4 0	—	—
Uak.	9	7 15 0	2,020	101 0 0	—	—	9	3 5 0	1,983	99 3 0	—	—
Savern.	177	50 0 0	5,000	250 0 0	—	—	190	64 13 0	6,941	347 1 0	—	—
Camel.	—	—	334	46 19 6	—	—	—	—	257	37 5 0	—	—
Fowey.	—	—	588	88 4 0	—	—	—	—	607	91 1 0	—	—
Avon and Erne.	—	—	459	49 19 0	—	—	—	—	333	42 7 0	—	—
Dart.	—	—	331	97 2 0	—	—	—	—	324	107 12 0	—	—
Teign.	—	—	368	46 0 0	—	—	—	—	355	44 7 6	—	—
Trent.	79	19 15 0	3,459	172 19 0	—	—	80	30 0 0	3,431	171 11 0	—	—
Yorkshire.	—	—	—	—	—	—	9	14 6 8	—	—	—	—
Wear.	—	—	1,242	62 2 0	—	—	—	—	1,445	72 2 0	—	—
Tyne.	—	—	1,901	118 12 6	3	4 0 0	—	—	1,935	123 6 6	1	2 0 0
Total.	387	156 18 4	21,808	1,919 11 6	4	4 5 0	408	175 18 0	23,430	1,985 6 0	6	2 10 0
												2,163 14 0

TABLE NO. III.—SUMMARY of the ESTIMATED NUMBER of SALMON FISHERMEN employed, and of the ACTUAL AMOUNT raised in LICENCE DUTIES on INSTRUMENTS used for the CAPTURE of SALMON in the Fishery Districts of England and Wales in the Years 1867–84.

Year.	Number of			Total Men.*	Revenue from			Total Revenue.
	Net Fisher-men.	Rod Fisher-men.	General Licences.		Nets.	Rods.	General Licences.	
					£	£	£	£
1867	3,029	2,350	39	5,379	3,851	1,816	430	6,097
1868	3,913	2,076	29	5,919	4,921	1,593	530	6,844
1869	3,083	2,030	24	5,113	4,826	1,420	320	6,566
1870	2,977	1,616	23	4,593	4,757	1,240	269	6,266
1871	3,383	2,054	26	5,437	5,370	1,469	307	7,146
1872	2,907	2,310	24	5,217	4,552	1,589	312	6,453
1873	2,990	2,579	20	5,348	4,650	2,031	143	6,824
1874	3,045	2,779	27	5,824	4,974	2,196	211	7,381
1875	2,970	2,605	24	5,575	4,715	2,086	202	7,003
1876	3,214	2,426	21	5,640	4,918	1,854	176	6,948
1877	3,319	2,712	23	6,031	5,160	2,036	169	7,365
1878	3,539	3,025	24	6,564	5,892	2,069	169	7,730
1879	3,099	3,317	27	6,416	4,736	2,270	170	7,176
1880	3,280	3,884	26	6,964	5,262	2,482	190	7,934
1881	3,054	3,795	27	6,849	4,777	2,430	205	7,412
1882	3,390	4,373	34	8,263	5,488	2,953	239	8,680
1883	3,410	4,339	40	8,249	5,668	3,069	250	8,987
1884	3,885	4,571	43	8,456	6,287	2,976	252	9,515

* Exclusive of men employed by holders of "general licences."

TABLE NO. IV.—SUMMARY of the NUMBER of TROUT LICENCES and of the AMOUNT raised in LICENCE DUTIES on INSTRUMENTS for the CAPTURE of TROUT in the Years 1879–84.

Year.	Number of		Revenue from			Total Revenue.
	Trout Rods licensed.	Other Instruments licensed.	Rods.	Other Instruments.	General Licences.	
			£	£	£	£
1879	9,103	99	674	45	—	719
1880	13,942	185	1,281	114	2	1,395
1881	17,520	285	1,546	143	2	1,691
1882	22,755	373	1,994	152	2	2,149
1883	21,808	387	1,919	157	4	2,080
1884	23,430	408	1,985	176	2	2,163

APPENDIX VI.—REVENUE AND EXPENDITURE.

Dr.

TABLE NO. I.—ABSTRACT OF ACCOUNTS OF VARIOUS BOARDS OF

		1	2	3	4	5	6	7	8	
	District.	To Revenue from Sale of Licences.	To Endorsements on Licences.	To Contributions from Fishery Association, including sale of Tickets for Trout.	To Penalties on Convictions.	To Voluntary Subscriptions.	To Interest of Stock or Rent of Real Property.	To Miscellaneous Receipts.	Total Receipts.	
1	Eden - - -	£ s. d. 904 6 6	£ s. d. 5 0 6	£ s. d. 52 3 9	£ s. d. 37 0 6	£ s. d. —	£ s. d. 9 17 6	£ s. d. —	£ s. d. 1,008 8 9	1
2	Derwent - - -	316 16 8	0 2 6	—	43 13 0	—	2 13 11	0 10 6	363 16 7	2
3	West Cumberland - - -	213 2 6	1 4 0	71 16 5	0 2 6	1 1 0	3 9 9	0 8 10	291 5 0	3
4	Kent - - -	392 9 2	—	—	3 19 10	—	40 0 0	5 10 8	441 19 8	4
5	Lune - - -	390 15 0	1 15 0	—	11 5 0	—	2 19 7	—	406 14 7	5
6	Ribble - - -	427 10 0	2 9 6	—	17 0 0	—	2 2 5	—	499 1 11	6
7	Dee - - -	584 15 0	—	—	9 0 0	—	3 1 11	4 18 11	601 15 10	7
8	Clwyd and Elwy - - -	96 10 0	—	52 0 0	17 2 6	26 18 0	—	0 3 5	192 13 11	8
9	Conway - - -	53 17 0	—	—	22 10 0	—	—	—	76 7 0	9
10	Seiont - - -	176 11 0	—	—	4 16 6	43 10 0	2 9 6	—	227 13 0	10
11	Dwyfach - - -	23 13 0	—	37 12 0	0 5 0	12 11 0	—	—	79 1 0	11
12	Dovey - - -	208 5 0	0 17 0	—	—	—	—	—	209 2 0	12
13	Ayron - - -	46 3 0	—	9 0 0	5 15 0	2 2 0	—	1 0 2	64 0 2	13
14	Teify - - -	324 16 0	4 12 0	—	21 13 0	—	—	—	361 1 0	14
15	Cleddy - - -	43 2 6	0 16 6	—	2 2 0	—	—	63 5 11 ⁶	114 6 11	15
16	Towy - - -	604 16 6	5 5 6	—	40 3 4	—	4 10 0	—	714 15 4	16
17	Ogmore - - -	20 13 6	—	35 14 0	—	—	—	—	56 7 6	17
18	Taff and Ely - - -	20 19 6	—	55 0 0	—	—	—	—	75 19 6	18
19	Rhymney - - -	8 14 0	—	—	1 13 0	20 0 0	—	—	30 7 0	19
20	Usk and Ebbw - - -	405 3 0	0 3 0	302 19 3	33 8 10	175 13 0	6 0 0	94 6 6	1,107 13 7	20
21	Wye - - -	408 10 0	3 10 6	—	15 0 0	8 0 0	—	—	525 0 6	21
22	Severn - - -	1,053 4 6	9 19 0	—	34 7 4	—	7 10 0	0 2 6	1,105 3 4	22
23	Avon,Brue, and Parret - - -	48 0 0	—	—	—	—	—	—	48 0 0	23
24	Taw and Torridge - - -	408 3 6	—	—	35 4 0	—	—	2 1 0	445 8 6	24
25	Camel - - -	04 5 0	0 0 6	6 2 6	3 8 0	—	—	—	73 16 0	25
26	Fowey - - -	139 8 0	1 10 0	—	4 11 6	—	—	3 14 0	149 3 6	26
27	Tamar and Plym - - -	120 2 6	—	—	0 6 0	—	—	—	120 8 6	27
28	Avon and Erme - - -	95 7 0	0 11 0	—	13 0 0	—	—	—	108 18 0	28
29	Dart - - -	265 9 6	—	—	—	5 17 0	—	4 12 0	275 18 6	29
30	Teign - - -	126 17 6	0 6 0	20 3 2	5 0 0	—	—	0 13 3	152 19 11	30
31	Exe - - -	210 10 0	—	—	0 13 9	5 0 0	—	—	216 3 9	31
32	Otter - - -	—	—	—	—	—	—	—	—	32
33	Axe - - -	25 0 0	—	—	1 0 0	—	—	0 13 6	26 12 6	33
34	Frome - - -	6 0 0	—	—	—	—	—	—	6 0 0	34
35	Avon and Stour - - -	199 0 6	0 17 6	—	—	—	—	—	199 17 6	35
36	Ouse (Sussex) ⁷ - - -	2 5 0	—	—	—	—	—	—	2 5 0	36
37	Rother - - -	—	—	20 0 0	—	—	—	—	20 0 0	37
38	Stour (Kent) ⁷ - - -	—	—	—	—	—	—	—	—	38
39	Trent - - -	373 1 0	0 15 0	—	10 10 9	25 19 0	—	0 5 0	410 10 9	39
40	Yorkshire - - -	393 1 8	4 7 0	—	54 0 9	1 1 0	—	0 6 0	452 16 5	40
41	Rsk (Yorkshire) - - -	85 2 6	0 0 6	30 0 0	4 4 0	—	—	—	119 7 0	41
42	Tees - - -	491 0 0	0 1 6	—	—	—	2 8 9	83 3 6	576 13 9	42
43	Wear - - -	126 7 0	—	—	15 11 6	—	0 15 0	1 10 0	144 3 6	43
44	Tyne - - -	1,195 16 6	0 3 6	—	22 8 6	—	—	12 3 0	1,230 11 6	44
45	Coquet - - -	285 15 0	0 1 0	—	12 10 0	—	—	0 5 0	298 11 0	45
	Total -	11,630 5 0	44 8 6	692 11 1	503 6 1	327 18 0	87 18 4	284 12 8	13,570 19 8	

¹ Including clothing and allowances.² Rent of fisheries.³ Including rent of fisheries, 597.⁶ Including interest on mortgage and repayment of part principal, 131l. 12s. 0d.⁷ The expense of preserving the river is borne by a private fishing society.⁸ Including 13l. 7s. 9d. received from C. Matthias, Esq., acting clerk from time of resignation of late clerk to appointment of present clerk, and 54l. 18s. 2d. received from late clerk, being a composition of 10s. in the pound on the amount due to the Board taken in full discharge.

N.B.—These accounts have been generally rendered for the year ended December 31st, 1884; but in a few cases, where it was twelve months for which the accounts of the Board have been audited.

The receipts in column 1 ought to correspond with the receipts from licences given in Appendix No. V., Tables I. and II. In the accounts of the Cleddy, Fowey, and Exe Boards, however, they do not do so exactly. In the case of the Cleddy, the clerk given in the returns at p. 67, being for salmon 64l. 16s. 0d., and for trout 27l. 8s. 0d. For further explanation see note ⁶ above. In the accounts for the agents till 1884. In the case of the Exe 5l. 10s. for licences issued remained unpaid when the accounts were

APPENDIX VI.—REVENUE AND EXPENDITURE.

CONSERVATORS FOR THE YEAR ENDED DECEMBER 31ST, 1884.

Cr.

	9	10	11	12	13	14	15	16	17	18	19
	By Salaries for Management.	By Wages for Superintendents and Water Bailiffs.	By Traveling Expenses.	By Commission on Sale of Licences.	By Cost of Prosecutions.	By Rewards on Convictions.	By Costs of Election.	By Construction of Fish Passes and other Works.	By Printing, Postage, and Advertisements.	By Miscellaneous Expenditure.	Total Expenditure.
1	75 12 0	735 6 9	197 4 11	4 7 0	10 16 6	—	8 16 8	—	20 14 7	1 0 0	953 18 5
2	—	262 0 1	3 18 3	3 18 0	18 2 0	0 10 0	—	1 10 0	17 14 4	4 14 10	322 7 6
3	16 0 3	173 15 0	—	—	4 8 6	—	—	27 19 5	7 17 10	35 0 2	267 7 2
4	23 0 0	322 15 11½	1 6 2	14 2 7	81 0 10	—	—	1 12 6	10 14 8	72 3 2	528 15 10½
5	65 0 0	192 17 0	13 0 9	—	26 0 6	8 5 0	1 13 6	0 15 6	9 3 3	4 5 5	321 5 11
6	50 0 0	284 12 0	21 13 3½	7 7 6	2 19 6	2 0 0	0 12 0	6 16 9	19 10 3	4 19 8	400 10 8½
7	36 0 8	351 0 6	27 15 11	16 0 4	37 15 0	3 15 0	—	157 2 0	9 10 2	480 1 5	719 1 0
8	5 5 0	124 7 0	7 16 10	6 17 0	29 16 2	8 18 9	—	—	3 9 2	4 6 7	190 16 6
9	20 0 0	45 18 0	1 13 0	—	4 12 6	10 19 6	—	—	1 9 0	—	84 12 0
10	15 0 0	145 18 6	6 13 3	10 6 6	54 3 9	1 10 0	—	31 4 1	4 13 8	7 3 2	276 12 11
11	15 0 0	78 2 6	1 7 0	—	—	0 10 0	—	—	1 9 6	0 16 0	97 5 0
12	20 0 0	169 9 5	—	1 18 3	17 12 10	—	—	—	3 1 6	—	209 2 0
13	—	44 18 6	—	0 7 6	3 0 0	—	—	—	4 10 0	5 5 0	58 1 0
14	35 0 0	223 1 6	14 10 0	11 2 4	1 10 0	—	2 7 0	—	6 17 11	51 1 0	346 9 9
15	6 0 6	42 0 4	—	—	—	—	—	—	—	1 16 7½	49 17 5½
16	30 0 0	636 16 8	24 7 10	5 18 7	19 4 7	—	2 7 9	—	25 0 5	28 12 6	772 8 4
17	1 1 0	54 12 0	—	0 15 6	—	—	—	—	0 3 6	1 1 0	57 13 0
18	—	62 8 0	3 9 0	1 0 11	—	—	—	—	6 0 10	5 11 0	78 9 9
19	5 0 0	29 19 3	—	0 6 0	3 2 6	—	—	—	2 0 0	1 15 5	42 3 2
20	70 0 0	799 1 7	—	19 19 0	32 19 7	—	—	31 3 5	16 8 6	41 11 3	1,011 3 4
21	67 9 0	155 0 2	24 16 4	12 16 9	27 11 6	6 0 0	—	—	7 1 9	24 7 6	325 3 0
22	146 9 6	603 16 4	29 0 4	111 1 4	58 10 6	—	—	41 15 6	105 2 5	69 0 4	1,164 16 3
23	5 5 0	17 10 0	2 18 0	1 4 0	—	—	—	—	3 10 7	2 2 0	32 9 7
24	25 0 0	308 17 6	1 13 3	21 8 0	28 13 6	—	1 13 6	—	12 4 3	52 14 11½	452 5 11
25	—	65 0 0	—	2 15 0	—	—	—	20 7 9	2 19 6	0 2 6	91 4 9
26	40 0 0	96 3 0	2 10 0	5 12 4	23 6 9	—	—	—	9 2 5	4 7 2	181 1 8
27	21 0 0	50 0 0	1 0 3	—	0 2 0	0 2 6	—	—	11 8 9	5 4 7	88 18 1
28	20 0 0	63 9 6	1 19 6	3 5 3	4 10 0	—	—	—	5 16 8	0 14 9	99 15 8
29	20 0 0	135 12 6	2 9 11	4 19 4	5 4 6	3 11 0	1 1 6	—	7 7 2	147 10 0	327 15 11
30	5 0 0	99 0 0	—	1 8 5	7 1 10	—	—	1 18 6	4 15 8	19 12 6	138 16 11
31	20 0 0	116 15 9	1 2 6	—	10 10 0	17 0 0	2 2 0	217 16 2	2 0 0	2 1 6	389 7 11
32	—	—	—	—	—	—	—	—	—	—	—
33	5 0 0	33 0 0	—	—	1 1 0	—	—	—	0 15 6	5 0 0	44 16 6
34	—	—	—	—	—	—	—	—	0 15 0	—	0 15 0
35	20 0 0	123 19 0	19 13 3	1 19 6	—	—	—	13 10 0	5 15 0	10 10 2	195 15 11
36	—	—	—	—	—	—	—	—	—	2 5 0	2 5 0
37	—	7 7 0	—	—	—	—	—	—	1 7 9	—	8 14 9
38	—	—	—	—	—	—	—	—	—	—	—
39	10 0 0	104 0 0	78 0 8	27 5 7	35 3 1	2 5 0	—	—	31 12 8	29 2 6	317 9 6
40	—	34 2 7	38 0 4	—	53 9 9	6 0 0	1 1 0	6 16 10	38 3 0	3 1 0	180 14 6
41	21 0 0	87 13 6	—	—	2 12 6	—	1 0 8	—	0 16 5	1 1 3	114 4 4
42	20 0 0	517 1 1	50 7 5	12 5 10	—	—	5 1 6	—	9 17 0	33 14 9	448 7 7
43	25 0 0	26 5 2	—	6 15 6	—	—	—	—	5 13 3	3 10 6	67 4 5
44	112 11 0	632 0 2	44 10 5	5 2 4	12 13 11	—	7 17 9	—	28 7 11	178 12 5	1,042 0 11
45	50 0 0	162 15 4	7 9 0	—	32 12 0	—	3 6 6	—	10 8 6	3 7 2	260 18 6
	1,123 13 11	8,687 9 14	530 7 44	322 1 2	650 12 7	71 6 9	39 12 4	500 8 5	473 10 0	950 1 8½	12,771 3 4½

* Including rent of office and incidental expenses, 59l. 7s. 11d.

* Including 13l. credited for fines unpaid.

* Including boat hire, 35l. 5s., and rent of Tynemouth fishery, 100l.

Receipts in 1884 : : : : : £13,570 19 8
 Expenditure in 1884 : : : : : £12,771 3 4½

Excess of receipts over expenditure (see next table) - £ 799 16 3½

It was impossible to obtain an exact statement for that particular period, the account has been rendered for the last complete

year, 1884, which are taken from the returns given in the answers to the ninth, tenth, and eleventh questions, in Appendix No. I. It is apparently entered in his accounts only the sums received for licences actually issued by him, the gross revenue from licences of the Powey 39 trout rod licences, producing 5l. 17s. 6d. entered in the Returns for 1884, were really issued in 1883, but not in 1884.

TABLE No. II.—ACCOUNT OF THE BALANCES OR DEFICITS OF VARIOUS BOARDS AT THE COMMENCEMENT AND CLOSE OF THE LAST ACCOUNTS.

District.	31st December 1883.*		31st December 1884.*	
	Balance in hand.	Deficit.	Balance in hand.	Deficit.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Eben - - -	371 8 4	—	425 18 8	—
Derwent - - -	—	33 10 2||	7 18 11	—
West Cumberland - - -	177 14 5	—	201 12 8	—
Kent - - -	282 0 11	—	195 4 8½	—
Lune - - -	82 15 10	—	168 4 6	—
Ribble - - -	195 6 7	—	243 17 9½	—
Dee - - -	216 5 9	—	99 0 7	—
Clwyd and Elwy - - -	13 12 7	—	15 10 0	—
Conway - - -	33 9 11	—	25 4 11	—
Seiont - - -	133 15 5	—	84 15 6	—
Dwyfach - - -	90 17 4	—	72 13 4	—
Dovey - - -	—	—	—	—
Ayron - - -	13 10 3	—	19 9 5	—
Teify - - -	49 12 8	—	55 3 11	—
Cleddy - - -	—†	—	64 9 5½	—
Towy - - -	261 18 11	—	204 5 11	—
Ogmore - - -	1 18 10	—	0 8 4	—
Taff and Ely - - -	3 15 1‡	—	1 4 10	—
Rhymney - - -	37 15 11	—	25 19 9	—
Usk - - -	515 10 0	—	612 0 3	—
Wye - - -	—	424 2 2	—	224 4 8
Severn - - -	301 18 8§	—	242 5 9	—
Avon, Brue, and Parret - - -	15 4 1	—	30 14 6	—
Taw and Torridge - - -	68 2 3	—	61 4 10	—
Camel - - -	26 15 2	—	9 6 5	—
Fowey - - -	309 17 6	—	277 19 4	—
Tamar and Plym - - -	183 9 5	—	214 19 10	—
Avon and Erme - - -	97 0 7	—	106 2 11	—
Dart - - -	152 17 0	—	100 19 7	—
Teign - - -	—	18 17 9	—	4 14 9
Exe - - -	202 9 4	—	29 5 2	—
Otter - - -	—	—	—	—
Axe - - -	15 4 9	—	—	2 19 3
Frome - - -	21 3 11	—	26 8 11	—
Avon and Stour - - -	176 18 7	—	181 0 2	—
Ouse (Sussex) - - -	—	—	—	—
Rother - - -	—	6 6 6	4 18 9	—
Stour (Kent) - - -	—	—	—	—
Trent - - -	165 16 6	—	258 17 9	—
Yorkshire - - -	—	47 11 2	224 10 9	—
Eak (Yorkshire) - - -	71 14 3	—	76 16 11	—
Tees - - -	231 18 7	—	360 4 9	—
Wear - - -	77 12 1	—	154 11 2	—
Tyne - - -	320 12 3	—	509 2 10	—
Coquet - - -	123 12 7	—	152 5 1	—
Total - - -	5,043 11 8	530 7 9	5,544 18 5½	231 18 8
£4,513 3 6				
Net balance 1884 -			£5,312 19 9½	
Deduct " 1883 -			4,518 3 6	
Excess of revenue over expenditure			£799 16 3½	
(see preceding Table) -				

* In some cases the accounts of the Board are not made up to the end of the year, and the balances and deficits given are those which are accounted for up to the date of the last audited accounts of the Board.

† The balance is returned as *nil* in the accounts of the Cleddy Board for 1884, but in the accounts for 1883 the balance was shown to be 80*l.* 3*s.* 4*d.* In the statement of account (see preceding pages) the sum of 54*l.* 18*s.* 2*d.* is returned under the head of "Miscellaneous receipts," as a receipt from "late clerk's," being a composition of 10*s.* in the *l.* on the amount due to the Board, taken in full discharge.

‡ So returned in the accounts of the Taff and Ely Board for 1884, but in the accounts for 1883 the balance was shown to be 4*l.* 16*s.* 1*d.*

§ So returned in the accounts of the Severn Board for 1884, but in the accounts for 1883 the balance was returned as 834*l.* 2*s.* 10*d.*

|| So returned in the accounts of the Derwent Board for 1884, but in the accounts for 1878 the balance was returned as 29*l.* 8*s.* 1*d.*

APPENDIX VII.—PROTECTION.

TABLE NO. I.—COMPARATIVE RETURN of the NUMBER of WATCHERS employed in the various DISTRICTS in 1881–82–83–84.

DISTRICT.	1881.			1882.			1883.			1884.		
	Permanent.	Temporary.	Total.	Permanent.	Temporary.	Total.	Permanent.	Temporary.	Total.	Permanent.	Temporary.	Total.
Eden - - -	9	4	13	9	4	13	9	2	11	9	4	13
Derwent - -	6	2	8	2	2	4	3	—	3	3	—	3
W. Cumberland	2	1	3	3	—	3	3	—	3	3	—	3
Kent - - -	3	1	4	5	—	5	5	—	5	5	—	5
Lune - - -	2	3	5 ¹	2	3	5 ²	2	5	7	2	5	7 ²
Ribble - - -	6	6	12	5	1	6	4	3	7	4	4	8
Dee - - -	4	38	42	4	25	29	5	25	30	5	2	7 ⁵
Clwyd and Elwy	2	2	4	2	2	4	2	2	4	2	2	4
Conway - - -	—	1	1	—	1	1	1	—	1	1	—	1
Seiont - - -	1	2	3	2	2	4	2	2	4	3	2	5
Dwyfach - -	1	2	3	2 ²	—	2	2	—	2	2	—	2
Dovey - - -	No returns.			— ⁹	—	—	—	—	— ⁹	—	—	— ⁹
Ayrton - - -	2	2	4	3	1	4	1 3	—	1	1	—	1
Teify - - -	—	—	—	—	—	—		3	6	3	—	3
Cledy - - -	2	2	4	1	2	3	3	1	4	1	2	3
Towy - - -	8	12	20	10	10	20	10	10	20	10	10	20
Ogmore - - -	1	—	1	1	—	1	1	—	1	1	—	1
Taff and Ely	1	—	1	1	—	1	1	—	1	1	—	1
Rhymney - -	—	1	1	—	1	1	—	1	1	—	1	1
Usk - - -	12	4	16	12	5	17	12	5	17	12	8	20
Wye - - -	3	20	23	2	26	28	2	5	7	2	7	9
Severn - - -	13	16	29	12	17	29	13	4	17	13	9	22
Avon, Brue, &c.	—	—	—	—	2	2	—	2	2	—	2	2
Taw & Torridge	3	1	4	3	—	3	3	3	6	3	3	6
Camel - - -	1	—	1	1	—	1	1	—	1	1	—	1
Fowey - - -	1	—	1	1	—	1	1	2	3	1	2	3
Tamar and Plym	3	—	3	4	2	6	4	1	5	4	2	6
Avon and Erme	3	3	6	3	2	5	3	2	5	3	2	5
Dart - - -	3	—	3	3	1	4	3	1	4	3	—	3
Teign - - -	1	1	2	2	1	3	1	1	2	1	1	2
Exe - - -	—	6	6	—	5	5	2	3	5	2	4	6
Otter - - -	—	—	—	—	—	—	—	—	—	—	—	—
Axe - - -	—	1	1	—	1	1	—	1	1	—	1	1
Frome - - -	—	—	—	—	—	—	—	—	—	—	—	—
Avon and Stour	1	—	1	1	—	1	1	3	4	2	4	6
Ouse - - -	1	—	1	1	—	1	1	—	1	1	—	1
Rother - - -	9	1	10	9	—	9	6	1	7	7	—	7
Stour - - -	3	—	3	3	1	4	3	2	5	3	2	5
Trent - - -	1	46	47	2	55	57	2	58	60	2	—	2
Yorkshire - -	—	—	—	—	1	1	—	1	1	—	1	1
Esk - - -	15	1	16	14	1	15	14	1	15	2	9	11
Tees - - -	4	1	5	4	— ¹	4	3	1	4	3	2	5
Wear - - -	1	—	1	—	2	2	—	2	2	—	3	3
Tyne - - -	7 ⁷	2	9	7 ⁸	2	9	7 ⁸	2	9	6 ⁸	4	10
Coquet - - -	2 ⁴	12	14	1	9	10	2	12	14	2	10	12
	137	194	331	137	187	324	141	167	308	129	108	237

¹ Others occasionally employed as required.² Several gamekeepers also acted as water-bailiffs.³ One of these was a constable.⁴ Six permanent and two temporary water-bailiffs are also employed on private preserves, and in addition about 20 gamekeepers and policemen hold water-bailiffs' certificates.⁵ Two of them were constables.⁶ Three of them were constables.⁷ No water bailiffs are employed by the Conservators, but the rivers are preserved by the local associations to whom the balance in the Conservators' hands is paid.

TABLE No. II.—COMPARATIVE RETURN of the NUMBER of PROSECUTIONS and CONVICTIONS under the SALMON FISHERY ACTS in each DISTRICT for the Years 1880-81-82-83-84.

District.	1880.		1881.		1882.		1883.		1884.	
	Charges.	Convictions.	Charges.	Convictions.	Charges.	Convictions.	Charges.	Convictions.	Charges.	Convictions.
Eden - -	24	24	36	32	75	68	77	73	58	56
Derwent - -	23	22	26	26	34	34	36	36	29	29
W. Cumberland - -	6	4	12	11*	23	20	16	14	10	9
Kent - -	5	4	5	5	4	4	15	12	8	8
Lune - -	12	10	7	7	13	12	14	14	9	9
Ribble - -	14	7	2	2	15	14	15	14	14	9
Dee - -	24	22	35	31	28*	24	30	24	26	24*
Clwyd and Elwy - -	17	8†	9	7‡	23	23	19	19	31	25
Conway - -	—	—	2	2	3	3	1	1	8	7
Seiont - -	4	4	20	20	32	10	5	5	14	7
Dwyfach - -	9	9	1	1	7	7	1	1	4	4
Dovey - -	26	21	No returns.		—	—	13	9	79	40
Ayrion - -	129	88	54	30	32	10	{ 18	15	11	6
Teify - -									27	18§
Cleddy - -	7	3	4	4	7	6	—	—	4	2
Towy - -	59	51	45	39	63	46	68	63	78	58
Ogmore - -	—	—	—	—	6	5	2	1	—	—
Taff and Ely - -	1	1	6	3	11	4	3	3	—	—
Rhymney - -	—	—	—	—	2	2	—	—	2	2
Usk - -	89	81	46	40	43	35	36	35	25	20
Wye - -	63	40	32	26	34	33	24	24	15	15
Severn - -	48	34††	20	17	8	5	46	35	61	54
Avon, Brue, &c. - -	—	—	—	—	2	2	—	—	—	—
Taw and Torridge - -	12	12	29	29	15	14	16	16	21	21
Camel - -	5	4	13	8	5	5	3	3	10	10
Fowey - -	6	4	8	7	5	5	1	1	5	3
Tamar and Plym - -	7	7	2	2	3	3	4	1	2	2
Avon and Erme - -	14	14	24	21	15	14	4	4	5	3
Dart - -	3	3	4	3	2	2	6	4	1	1
Teign - -	5	1	4	1	11	11	8	8	8	8
Exe - -	25	20	1	1	9	9	15	10	19	17
Otter - -	—	—	—	—	—	—	—	—	—	—
Axe - -	2	2	2	—	2	2	10	7	5	3
Frome - -	—	—	—	—	—	—	—	—	—	—
Avon and Stour - -	—	—	6	6	—	—	—	—	—	—
Ouse - -	—	—	—	—	—	—	3	3	—	—
Rother - -	—	—	—	—	—	—	—	—	—	—
Stour - -	—	—	—	—	—	—	—	—	—	—
Trent - -	32	31	29	20	38	30	37	34	29	21
Yorkshire - -	10	10	2	—	51	15	9	6	32	24
Esk - -	8	3	4	3	4	4	—	—	4	3
Tees - -	13	10	19	17	18	11	13	10	13	13
Wear - -	6	6	10	10	12	12	8	8	11	11
Tyne - -	55†	48	54‡	49	33	31	41	38	73	59
Coquet - -	49	37	31	21	15	10	34	22	20	16
	807	645	604	501	703	545	651	573	781	617

* And one defendant absconded.

† And warrant out for apprehension of three defendants.

‡ And one warrant issued.

† And 16 defendants absconded before service of summons.

§ And two defendants absconded.

¶ And 13 defendants absconded before service of summons.

APPENDIX VIII.

FRESHWATER FISH.

The following is a LIST of the FISHERY DISTRICTS which have been EXEMPTED, wholly or in part, under the 11th section (sub-section 7) of the FRESHWATER FISHERIES ACT, 1878, from the provisions of the 1st, 2nd, and 3rd sub-sections of the 11th section of that Act, which provide a close time for "freshwater fish"* from 15th March to 15th June. (This list is made up to the 31st May 1885):—

District.	Extent of District exempted.	Kinds of "Freshwater Fish"* to which the Exemption extends.
AVON AND ERME -	The whole - - -	All.
AVON AND STOUR -	The whole - - -	All.
EDEN - -	The whole - - -	All.
KENT - -	The whole - - -	Pike.
SEVERN -	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 5px;">{</div> <div> The whole - - - The whole, except the Severn below the mouth of the Verniew, in the counties of Salop, Stafford, Worcester, and Gloucester, and except so much of the Avon as flows through Worcestershire and Gloucestershire. </div> </div>	Pike. All, except grayling.
TOWY - -	The whole - - -	All.
WYE - -	The whole - - -	All.
YORKSHIRE -	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 5px;">{</div> <div> The whole - - - So much of the Ouse as lies between 100 yds. below Linton Dam, and 100 yards above Naburn Dam. </div> </div>	Pike. All.

* NOTE.—For the purposes of the section of the Act above referred to, "freshwater fish" are defined to include all fish (other than pollan, trout, and char) which live in fresh water, and do not migrate to and from the open sea.

APPENDIX IX.

LIST OF SPECIAL REPORTS BY THE INSPECTORS OF FISHERIES (ENGLAND AND WALES).

The following is a list of the various special printed Reports by the Inspectors of Fisheries (England and Wales) on Inquiries held under the provisions of the Salmon Fishery Acts 1861-1876 and otherwise.

No.	Date.	Titles of the Reports.	Remarks.
1	1st July 1871.	Report by Mr. Frank Buckland, Inspector of Fisheries for England and Wales, and Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries on the effect of recent legislation on the Salmon Fisheries of Scotland.	Presented to Parliament [C. 419.] 1871.
2	6th May 1874.	Report by the Inspectors of Fisheries on the Byelaw proposed by the Tyne Board of Conservators, prohibiting the use of Nets near the Mouth of the River Tyne.	
3	18th Dec. 1874.	Report by the Inspectors of Fisheries on the Byelaw proposed by the Tees Board of Conservators, altering the Annual Close Season for Salmon in the Tees Fishery District.	
4	21st Dec. 1874.	Report by the Inspectors of Fisheries on Wye Byelaws.	Reprinted in House of Commons Paper, No. 294, 1875.
5	21st Dec. 1874.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on an inquiry into the affairs of the Herne Bay Oyster Fishery Company.	Reprinted in House of Commons Paper, No. 17-(1), 1875.
6	10th April 1875.	Report by the Inspectors of Fisheries on an Inquiry into Byelaws proposed by the Conservators of the Avon, Brue, and Parret Fishery District altering the Annual Close Season for Salmon, and regulating the use of Nets for Fish other than Salmon in the Annual and Weekly Close Seasons for Salmon, in that District.	
7	10th April 1875.	Report by the Inspectors of Fisheries on an Inquiry into a Byelaw proposed by the Conservators of the Severn Fishery District prohibiting the use of Nets for Fish other than Salmon in the Weekly Close Season for Salmon in that District.	

No.	Date.	Titles of the Reports.	Remarks.
8	10th April 1875.	Report by the Inspectors of Fisheries on an Inquiry into a Byelaw proposed by the Conservators of the Teify and Ayron Fishery District altering the Annual Close Season for Salmon in that District.	
9	28th April 1875.	Report by Mr. Spencer Walpole, Inspector of Fisheries on an Application of the Conservators of the Taw and Torridge Fishery District to acquire compulsorily a piece of Land at Monk Okehampton Weir, on the River Okement.	
10	30th April 1875	Report by the Inspectors of Fisheries on the Byelaw proposed by the Conservators of the Lune Fishery District altering the Annual Close Season for Fishing for Salmon in the Lune Fishery District.	
11	31st May 1875.	Reports by the Inspectors of Fisheries on an Application made by the Conservators of the Tees Fishery District for leave to purchase compulsorily Dinsdale Dam and the Premises connected therewith.	
12	1875.	Report of Mr. Spencer Walpole, Inspector of Fisheries for England and Wales, and Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries on the operation of the Tweed Fisheries Act.	Presented to Parliament [C. 1117.] 1875.
13	9th Aug. 1875.	Report by Mr. Frank Buckland, Inspector of Salmon Fisheries on the Fisheries of Norfolk, especially Crabs, Lobsters, Herrings, and the Broad.	Printed in House of Commons Paper, No. 428, 1875.
14	8th Feb. 1876.	Report by Mr. Spencer Walpole on an Inquiry held by him at Herne Bay, by Order of the Board of Trade, under the Provisions of the Sea Fisheries Acts, to inquire into the Manner in which the Herne Bay, Hampton, and Reculver Oyster Fishery Company are cultivating the Oyster Grounds within the limits of the Fishery granted to them by the Herne Bay Fishery Act, 1864.	Reprinted in House of Commons Paper, No. 65, 1876.

No.	Date.	Titles of the Reports.	Remarks.
15	20th June 1876.	Report by the Inspectors of Fisheries on the Provisions of the 15th section of the Salmon Fishery Act, 1873, relating to Elver Fishing in the Severn.	Reprinted and presented to Parliament by Command. [C. 1533.] 1876.
16	3rd October 1876.	Report by the Inspectors of Fisheries on a Byelaw made by the Conservators of the Fowey (Cornwall) Fishery District, altering the Close Season for Salmon in that District.	
17	28th Feb 1877.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on a Byelaw made by the Conservators of the Dee Fishery District, altering the Close Season for Trout in that District.	
18	1st March 1877.	Reports by the Inspectors of Fisheries on the Crab and Lobster Fisheries of England and Wales, and (in conjunction with Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries) of Scotland.	Presented to Parliament by Command. [C. 2766.] 1877.
19	25th April 1877.	Report by the Inspectors of Fisheries on a Byelaw made by the Conservators of the Taw and Torridge Fishery District, regulating the use of Nets for Fish other than Salmon during the Annual and Weekly Close Seasons for Salmon in that District.	
20	25th April 1877.	Report by the Inspectors of Fisheries on the Effect of the Salmon Fishery Laws on Fisheries for Sea Fish other than Salmon within the Towy Fishery District.	See also No. 24 (<i>infra</i>). Reprinted at p. 112 of 18th Annual Report of Inspectors.
21	26th April 1877.	Report by the Inspectors of Fisheries on an Application made by the Conservators of the Cleddy Fishery District to extend the limits of that District by including therein a portion of the Teify and Ayron Fishery District.	
22	22nd June 1877.	Report by the Inspectors of Fisheries on the Device approved by the Home Office for closing Putts and Putchers during the Weekly Close Time.	Reprinted at p. 118 of 18th Annual Report of Inspectors.
23	17th July 1877.	Report by the Inspectors of Fisheries on the use of dynamite for killing fish.	Presented to Parliament by Command. [C. 1819.] 1877.

No.	Date.	Titles of the Reports.	Remarks.
24	17th Dec. 1877	Final Report by the Inspectors of Fisheries on the Effect of the Salmon Fishery Laws on Fisheries for Sea Fish other than Salmon.	Continuation of No. 20 (<i>supra</i>). Reprinted at p. 115 of 18th Annual Report of Inspectors.
25	1st March 1878.	Report by the Inspectors of Fisheries, in conjunction with Mr. Archibald Young, Commissioner of Scotch Salmon Fisheries, on the Herring Fisheries of Scotland.	Presented to Parliament. [C. 1979.] 1878.
26	2nd April 1878.	Report by the Inspectors of Fisheries on the Fisheries of the English Lake District.	Reprinted and presented to Parliament by Command. [C. 2004.] 1878.
27	18th April 1879.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on a Byelaw made by the Conservators of the Yorkshire Fishery District, altering the Close Season for Salmon in that District.	
28	10th June 1879.	Report by the Inspectors of Fisheries on the Provisions of a Bill for the Amendment of the 39th Section of the Salmon Fishery Act, 1873.	Reprinted and presented to Parliament by Command. [C. 2337.] 1879.
29	1st Sept. 1879.	Report by the Inspectors of Fisheries on the Sea Fisheries of England and Wales.	Presented to Parliament. [C. 2449.] 1879.
30	9th Sept. 1879.	Report by the Inspectors of Fisheries on certain Byelaws made by the Conservators of the Dee Fishery District altering the Close Time for Salmon in that District.	
31	1st Dec. 1879.	Report by Mr. F. Buckland and Mr. S. Walpole, the Inspectors appointed by the Board of Trade to hold an Inquiry respecting an Application made under the Fisheries (Oyster, Crab, and Lobster) Act, 1877, for an Order restricting the taking of Crabs and Lobsters on a Portion of the Coast of Norfolk.	Printed in House of Commons Paper, No. 70, 1880.
32	24th Jan. 1880.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on a Byelaw made by the Conservators of the Eden Fishery District, altering the Weekly Close Season for Salmon in that District.	Reprinted at p. 37 of 20th Annual Report of Inspectors.

No.	Date.	Titles of the Reports.	Remarks.
33	2nd Aug. 1880.	Report by the Inspector of Fisheries, in conjunction with Mr. Young, Commissioner of Scotch Salmon Fisheries, on the disease which has recently appeared among the Salmon in the Tweed, Eden and other Rivers in England and Scotland.	Presented to Parliament [C. 2660.] 1880.
34	2nd Aug. 1880.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on an Inquiry into certain Byelaws made by the Conservators of the Camel and Fowey Fishery Districts, in the County of Cornwall, altering the Close Season for Salmon and Trout.	Reprinted at p. 39 of 20th Annual Report of Inspectors.
35	31st Oct. 1880.	Report by Mr. Spencer Walpole, Inspector of Fisheries, on an Inquiry into a Byelaw made by the Conservators of the Seicent (Carnarvonshire) Fishery District, regulating the Use of Nets for Fish other than Salmon during the Close Season for Salmon in that District.	Reprinted at p. 43 of 20th Annual Report of Inspectors.
36	30th Nov. 1880.	Report on the Laws affecting the Salmon Fisheries of the Solway Firth, by Mr. Spencer Walpole and Mr. Archibald Young (Commissioner of Scotch Salmon Fisheries).	Presented to Parliament by Command. [C. 2769.] 1881.
37	31st Dec. 1880.	Report of Mr. Spencer Walpole, Inspector of Fisheries, on the destruction of Fish at Billingsgate in consequence of the alleged inadequate accommodation at Billingsgate Market.	Reprinted in House of Commons Paper, No. 385, 1881.
38	6th April 1881.	Report by the Inspectors of Fisheries on an Inquiry into the changes of the Law, if any, which are required to remove the Grievances to which it is alleged that the Disturbances which occurred during the past Winter in Radnorshire in carrying out, or in defiance of, the Provisions of the Salmon Fishery Acts, 1861 to 1876, are attributable.	Reprinted and presented to Parliament by Command. [C. 2918.] 1881.
39	31st July 1881.	Report by the Inspectors of Fisheries on an Inquiry into a proposed Byelaw altering the Minimum Size of the Mesh of Nets for taking Salmon in the Ribble Fishery District.	Reprinted at p. 29 of 21st Annual Report of Inspectors.

No.	Date.	Titles of the Reports.	Remarks.
40	24th Aug. 1881.	Report by Mr. Spencer Walpole on an Inquiry held by him at Herne Bay, by Order of the Board of Trade, under the Provisions of the Sea Fisheries Acts, to inquire into the Manner in which the Herne Bay, Hampton, and Reculver Oyster Fishery Company are cultivating the Oyster Grounds within the Limits of that Portion of the Fishery granted to them by the Herne Bay Fishery Act, 1864, which remained vested in them in July 1881.	Printed in House of Commons Paper, No. 4, 1882.
41	6th Oct. 1881.	Report by the Inspectors of Fisheries on an Inquiry into certain Byelaws, and a Scale of License Duties, proposed by the Conservators of the Teify and Ayron Fishery District.	Reprinted at p. 32 of 21st Annual Report of Inspectors.
42	25th Jan. 1883.	Report by Mr. T. H. Huxley the Inspector appointed by the Board of Trade to hold an Inquiry respecting an Application made under the Fisheries (Oyster, Crab, and Lobster) Act, 1877, for the Renewal of an Order restricting the taking of Crabs and Lobsters on a portion of the Coast of Norfolk.	Printed in House of Commons Paper, No. 44, 1883.
43	23rd Feb. 1883.	Report by the Inspector of Fisheries on a Byelaw made by the Conservators of the Avon and Stour Fishery District, regulating during the Annual and Weekly Close Seasons for Salmon the use of Nets for Fish other than Salmon	Reprinted at p. 34 of 22nd Annual Report of Inspector.
44	10th July 1884.	Report by the Inspector of Fisheries on an Inquiry into a Byelaw altering the Annual Close Season for Salmon in the Derwent (Cumberland) Fishery District.	Reprinted at p. 39 of 24th Annual Report of Inspector.
45	20th Oct. 1884.	Report by the Inspector of Fisheries on an Inquiry into a Byelaw varying the Close Time for Salmon in the Taw and Torridge Fishery District.	Ditto. (p. 44.)
46	20th Oct. 1884.	Report by the Inspector of Fisheries on an Inquiry into a Byelaw altering the Annual Close Season in the Avon and Erme Fishery District.	Ditto. (p. 47.)

D. TROUT AND CHAR EXCLUSIVELY OF SALMON;

DR

NAMES AND ADDRESSES OF		No. of Dis- trict.
BOARDS OF CONSERVATORS.	CLERKS TO BOARDS OF CONSERVATORS.	
Firill, Penrith - -	T. H. Hodgson, The Courts, Carlisle - -	1
Magdalen Hall, Dartington,	A. Pike, Clifton Villa, Bridgetown, Totnes - -	29
and Min Castle, Exeter -	Sid. Hacker, Newton Abbot - - - -	30
Mativerton - - -	B. J. Ford, 25, Southernhay, Exeter - -	31
Fel - - - -	F. R. Jeffery, Ottery St. Mary - - - -	32
th House, Axminster -	W. Forward, Axminster - - - -	33
Fel Blandford, Dorset -	P. E. L. Budge, Wareham - - - -	34
Febone, Blandford, Dorset -	R. D. Sharp, Solicitor, Christchurch - -	35
Apryk, Lewes - - -	F. Holman, Lewes - - - -	36
Fel Playden, Sussex -	T. J. Smith, Rye - - - -	37
Ma - - - -	Capt. Lambert, Stanmore, Canterbury; Assistant Sec., F. G. Haines, 9, Watling Street, Canterbury.	38
Fel Park, near Ollerton, get, Park Lane, London.	C. K. Eddowes, Solicitor, 40, St. Mary's Gate, Derby.	39
st d'Art, Norton Conyers,	J. H. Phillips, 22, Albemarle Crescent, Scarborough	40
t Fel Hall, Sleights, York -	W. Brown, 8, Baxtergate, Whitby - -	41
: Fel House, Darlington -	M. B. Dodds, Stockton-on-Tees - - -	42
: Felreet, Sunderland -	Collin Smart, John Street, Sunderland - -	43
t Fel Hall, Humabaugh, North-	R. Gibson, Hexham - - - -	44
st Japuse, Dudley, Northum-	T. Tate, Alnwick - - - -	45

THE I., AND THOSE REGULATING

sh other than Salmon in Annual and Weekly
Close Seasons.*

apply to any part of the district where there is a

The use of Nets
in Inland
Waters, ex-
cept a Land-
ing Net or a
Net for tak-
ing Eels, is
prohibited
between the
first Hour
after Sunset,
and the last

The Districts
marked †
have adopted
a Byelaw re-
gulating the
Marks and
Labels to be
attached to
Nets, Boats,
etc.

The Districts
marked §
have adopted
a Byelaw re-
gulating the
Forms of Li-
cences to be
used, and the

No.
of
Dis-
trict.

in any public water having a mesh of less
than 1 knot to knot or 6 inches round, measured
up to 30th November.
in any public water except a trawl net, from

no net of any description to be used for
close seasons nets not to be used above South-
than that used for salmon.

—	†	§	23
*	†	§	24
—	†	§	25
*	†	§	26
—	—	—	27
*	—	§	28
—	†	§	29
—	†	§	30
*	†	§	31
—	—	—	32
*	†	§	33
—	—	—	34
*	†	§	35
*	†	§	36
*	†	§	37
—	—	—	38
*	—	§	39
*	†	§	40
—	†	§	41
—	†	§	42
—	†	§	43
—	†	§	44
*	†	§	45

ediz

INF THE SALMON FISHERY ACTS, 1861-1876.

D

LEADER TO PUTTS OR PUTCHERS.		CROSS LINE.	ANY INSTRUMENT NOT SPECIFIED.	No. of Dis- trict.
ing 100 Yards.	For every additional 20 Yards.			
1. 5	- -	2l.	—	1
1. 5	- -	2l. 10s.	—	2
5s.	1l. - -	2l. 10s.	—	42
5s.	1l. . -	2l. 10s.	—	43
5s.	1l. - -	2l. 10s.	—	44
5s.	1l. - -	2l. 10s.	—	45

CE
AL

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15s.

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on

For regulations as to Close Season for Freshwater Fish, see Appendix VIII., and for Licence Duties for Trout and Char, see Tables I. and III.)

DISTRICT. (N.B. — The districts are taken in geographical order, from N.W. round the coast to N.E.)	Kinds of Instruments that may be lawfully used for Freshwater Fish, and Regulations as to their use. N.B.—These Byelaws do not apply to fixed nets for taking eels nor to landing nets used as auxiliary to angling with rod and line.	Minimum Size of Mesh of Nets for taking Freshwater Fish. *Note.—The measurement is in all cases to be made from one knot to the next knot, and when the net is wet.
KENT	<p>All modes or instruments prohibited, except set nets for pike, night lines for taking eels, draft nets angling with rod and line, fishing for char with the plumb line, fishing with a hand line for perch, setting trimmers for pike, using a landing net as auxiliary to fishing with any lawful instrument not being a draft net, and using a dip net for catching bait.</p> <p>The length, size, and description of nets that may be lawfully used, and the manner of using the same, as follows:—</p> <p>A floating draft net, which is a draft net buoyed so that the head-rope of the net will float on the surface of the water, not exceeding 90 yards in length, measured along the head-rope, and 9 yards in depth from the deepest part of the net to the centre of the head-rope; the ropes at either end of the net used in working the same not to exceed 50 fathoms in length respectively.</p> <p>A sunken draft net, not exceeding 35 yards in length, measured along the head-rope, and 6 yards in depth from the deepest part of the net to the centre of the head-rope; the ropes at either end of the net used in working the same not to exceed 150 fathoms in length.</p> <p>All draft nets to be used by retaining one end of the net or one end of the hauling-rope attached thereto on the shore; and from that point shooting the net into the water as far, but no farther than the hauling-rope so attached will admit of, the hauling rope attached to the other end of the net being used to haul the net after being shot, to the shore, or to a boat fixed to the shore, such fixed boat to be not more than 5 yards from the shore.</p> <p>Dip nets for catching bait to be circular, not more than 13 feet in circumference, the bag of such net not to be more than 3 feet in depth from the outside of the circumference of the net.</p>	1½ inch.
RIBBLE TOWY	<p>The use of any instrument or mode of fishing, other than angling, is prohibited, except only when the exclusive right of fishing on both sides of any stream, not being a mill-race or other artificial water-course, belongs to the same owner, or jointly to different owners on each side, it shall be lawful for such owner or joint owners, if they combine, to take or to authorise in writing any person to take fresh-water fish within the limits of his or their fishery with any duly licensed instrument. Provided that every person so authorised shall on demand produce the document by which he is authorised to any person demanding it, and in default shall not be deemed to be an authorised person.</p> <p>No net to be used during the annual and the weekly close seasons for salmon, nor between sunset and sunrise.</p> <p>The use of a rod and line by any person, while he is wading or standing in the water, is prohibited in the river Tave and in the tributaries thereof, and in the river Gwendraeth-fach.</p> <p>[These byelaws do not extend to any private lake or fishpond, nor to the backwaters of the river Towy below Llandilo Bridge, nor to dip or casting nets used for catching fish for bait.]</p>	2 inches. 1 inch.
USK WYE	<p>All modes of fishing prohibited except:—</p> <p>Rod and line.</p> <p>Casting net or dip net, legally used for taking bait.</p> <p>Draft net or trammel net for the purpose of destroying fresh-water fish other than trout or grayling.</p> <p>Night lines.</p> <p>Trimmers for pike.</p> <p>Nets not to be used between sunset and sunrise.</p> <p>[These byelaws do not apply to the rivers Lugg & Dore.]</p> <p>No nets except cast nets and dip nets to be used except by owners of the fishery or other persons by them authorised in writing.</p> <p>No net to be used within 50 yards above or below any mill.</p> <p>The following modes of fishing are prohibited:—</p> <p>Landing or hauling out a hole in a bank, tickling or groping (except by owners of the fishery or other persons by them authorised in writing), snaring, snatching and shooting.</p>	1 inch. 1 inch.
TRENT		

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For Her Majesty's Stationery Office.**

THIRD
ANNUAL REPORT
OF THE
FISHERY BOARD FOR SCOTLAND
Being for the Year 1884.

**Presented to both Houses of Parliament in pursuance of
Act 45 and 46 Vict., cap. 78.**



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THIRD ANNUAL REPORT.

TO THE RIGHT HONOURABLE

SIR WILLIAM VERNON HARCOURT, M.P.,

Her Majesty's Principal Secretary of State for the Home Department.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 1st May 1885.

SIR,

We, the Members of the Fishery Board for Scotland, appointed under the Fishery Board (Scotland) Act, 1882, have the honour to submit our Third Annual Report, in terms of the fifth section of that Act.

THE FISHERIES OF SCOTLAND.

The Herring Fishing of 1884 was the most abundant ever known. Unfortunately, however, it was largely composed of immature and small fish, and, on this account, it was of much less value than it would otherwise have been. The high prices which herrings brought during recent years led to agreements being entered into for last season's catch, under which the fishermen were to get from the curers more bounty money than had ever been paid before, and full prices for the herrings taken during the season.

Herring
Fishery.
Fishing of
1884 most
abundant
ever known.
Agreements
between
Curers and
Fishermen.

Great shoals of young herrings were found far out at sea much earlier than usual; and before they had time to mature, the boats went out to capture them, and landed very heavy takes. The curers as a rule declined to receive these fish at the prices fixed for the season until the day when the agreements began to take effect; and the fishermen sometimes found it impossible to sell their takes at all. After the agreements came into force, the fishing continued very abundant, but large quantities of the herrings captured were still so small as to be of comparatively little value. Sometimes the takes landed were so heavy, that the curers were

Great takes of
young
Herrings.

Curers decline
to purchase
them till
agreements are
in operation.

Difficulty in
getting heavy
takes cured

Many boat-loads thrown overboard.

unable, especially when there were late deliveries, to get one day's catch salted before the next day's catch arrived; and it often happened that many boat-loads of herrings were thrown back into the sea, and that others were used for manure.

Matters similar at nearly all Stations.

This state of matters, with some exceptions, existed more or less at nearly all the stations, but particularly over the extensive range of coast embracing Fraserburgh and Wick. As mentioned in the report of the district of Fraserburgh, the fishing there of one day alone (July 15th) yielded about 20,000 crans, of which, owing to its being so great a catch, and to some of the boats being late in getting back to harbour, upwards of 6000 crans had to be thrown overboard, while 3000 crans were carted away for manure. The finest herrings of the year were captured in the Shetland district. A portion of the catch at Orkney was also good, and towards the end of the season an improvement took place on those landed at Peterhead. From Peterhead southwards, as far as the Eyemouth district, many of the takes were also of good quality. Over the whole West Coast, the fish generally were of a smaller size than usual.

Stations where quality was better.

Herrings small all over West Coast.

Market glutted, and fall in Prices. High Railway Rates prejudicial to distribution of Fish.

In consequence of what has been stated above, the market became glutted with cured herrings, and a great fall in prices took place, especially of maties and immature fish. But had the railway charges for fish transit been considerably lower than they were, a large quantity of herrings, for which no market could be found, would have been distributed over Scotland and England in a fresh or lightly salted state. At present, the cost of carriage is often much more than the value of the fish, and in many centres of population herrings can only be sold at prices so high as to place them beyond the reach of the poorer classes.

Pecuniary results of Season.

In so far as the fishermen were concerned, the season was a most profitable one. Unfortunately, it was otherwise with the fish-curers, many of whom sustained serious loss.

Value of the different Fisheries in 1884.

In a subsequent part of the Report, it will be seen that the estimated value of the herrings which were cured last year, was £2,121,346, 11s. 3d., and of those which were sold fresh, £150,720, making together £2,272,066, 11s. 3d.; that the estimated value of other white fish was £723,844, 1s.; of shell fish, £80,939; and of salmon, £275,000,—the gross total estimated value of the fisheries of Scotland for the year 1884 being £3,351,849, 12s. 3d.

No means of making comparison with former years.

The collection of returns of the entire produce of these fisheries was begun by this Board in April 1883; but as no such statistics were ever collected before, means do not exist for making a comparison between the value of all the fisheries in the year 1884 and of any former year; but it is believed that the produce of that year was quite as great as the average of recent years.

Importance of Sea Fisheries to Scotland.

It is difficult to form an adequate idea of the immense importance of their sea fisheries to the people of Scotland. But it may be stated that the number of persons employed last year in connection with this industry was estimated at 103,804, so that, including families, there may be half a million of people, or about one-seventh of the entire population of Scotland (which by

the census of 1881 amounted to 3,735,573 persons), more or less dependent upon them.

While, however, as mentioned above, it is believed that the produce of the sea fisheries of Scotland last year was quite equal to the average of recent years, many fishing grounds which formerly yielded large quantities of food-fishes are now all but unproductive. Other grounds, again, are now yielding year by year great takes of fish, where at a previous period scarcely any were to be found. In former years, for example, the herring fishery at the Shetland Islands was an abundant one, but thereafter it fell away, and in 1874 it only produced 1100 barrels of cured herrings, which at 25s. a barrel, amounted to the small sum of £1375. Since 1874, however, it has gone on increasing, and last year it yielded no less than 300,117 barrels, which at 25s. each, amounts to £375,146, 5s.

The causes of such changes in the productiveness of fishing grounds are to a great extent unknown. Since its constitution, the Board has devoted much attention to the whole bearings of this question, in the hope that means might be found for restoring exhausted fishing grounds to their former state of fertility. As the result of experiments carried on in the Moray Firth, at St Andrews, and at Ballantrae, and from the information gained by Professor Ewart in the United States, the Board believes that, with sufficient funds and increased powers, the numbers of the less migratory fish might be greatly increased in the territorial waters, while steps might be taken to attract annually large numbers of cod, haddock, and other migratory forms to the inshore fishing grounds.

Happily, the country is now beginning to realise the great importance of this matter, and the Government have placed at the disposal of the Board money to carry on scientific investigations in connection therewith, and it is hoped that the produce of the Scottish fisheries, great as it now is, may still be largely increased. Particulars of what the Board has done in scientific investigation are given in this, and its two previous Annual Reports presented to Parliament, to which reference is made.

HERRING FISHERY.

The totals of the herrings cured in each of the last five years are:—

Years.	Barrels cured.	Barrels cured in last five years.
1880,	1,473,600½	
1881,	1,111,155½	
1882,	1,282,973½	
1883,	1,269,412½	
1884,	1,697,077½	

These results show that the fishing of 1884, as compared with that of 1883, yielded an increase of no less than 427,664½ barrels, or 33·6 per cent. Both the East and West Coasts contributed to this rise, but more especially the former. The increase on the east coast was 408,145 barrels, being 38·9 per cent., and on the west coast, 19,519½ barrels, or 8·8 per cent.

Results of 1883
and 1884 com-
pared.

The particulars of the results of the fishing of last year when compared with those of 1883, in the herrings cured, branded, and exported, and in the amount of brand fees received, are as follow :—

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees.
1883, . . .	1,269,412½	470,995½	890,760½	£7,849 18 6
1884, . . .	1,697,077½	653,425	1,185,220½	10,890 8 4
Increase in 1884,	427,664½	182,429½	294,460	£3,040 9 10

Increase in
1884 on average
of preceding
ten years.

A comparison of the results of 1884, with the average of those of the preceding ten years, shows a large increase in all the items, viz. :—

Years.	Barrels Cured.	Barrels Branded.	Barrels Exported.	Brand Fees.
Average of ten years } 1874–1883, . . }	1,027,416½	460,823	700,805	£7,680 7 8
Year 1884, . . .	1,697,077½	653,425	1,185,220½	10,890 8 4
Increase in 1884, .	669,660½	192,602	484,415½	£3,210 0 8

WEATHER.

Weather.
Its importance
to the
Fisheries.

The state of the weather has now more effect than formerly in influencing the prosperity of the sea fisheries, particularly those for herrings, cod, and ling, as these industries are now most successfully prosecuted at a considerable distance from land, varying from 30 to 120 miles; and it is of the utmost consequence that the wind should be such that the boats can get quickly back from the fishing grounds, so as to land their fish without much loss of time.

State of
Weather
during Summer
Herring
Fishing.

During the whole of the summer herring fishing of last year, the season was one of extraordinary mildness, and there were no storms to detain the boats on shore, or to force them to make for land before working their nets. The only interruptions to the regular prosecution of this fishing were occasional fogs and calms, which occurred about the end of July and beginning of August; but, nevertheless, there was not a single night in the whole season when some of the

boats were not at sea. During the early herring fishing at the Outer Hebrides, the weather was also remarkably good, except at its commencement in May. The winter herring fishing at Ballantrae, however, suffered greatly on account of storms. The fishermen had frequently to remain on shore when there were large shoals of herrings upon the coast, and some of the seine-net boats were not at sea more than four or five times during the season.

During Early Herring Fishing.
During Winter Herring Fishing at Ballantrae.

Notwithstanding, however, the favourable state of the weather during the summer and autumn herring fishing of 1884, the Board has unhappily to record that no fewer than 73 lives were lost during that year—43 on the East Coast and 30 on the West Coast—in connection with the sea fisheries. Further, 39 boats were totally wrecked, and 112 were damaged, causing an estimated loss of £6342. A loss on nets and other fishing material was also incurred amounting to about £23,164. Detailed particulars of these casualties will be found in Table V, Appendix D, to which reference is made; and it may be stated that such information has for the first time been collected in Scotland.

73 lives lost.
Loss on Boats, Nets, &c.
Particulars of Casualties.

EAST COAST HERRING FISHERY.

Following the course which has been adopted for the last two years, some details will now be given, taken from the reports of the inspectors and district officers, regarding the herring fishery of 1884, in each of the twenty-six districts into which the coasts of Scotland are divided, beginning with the seventeen on the East Coast. These are—Eyemouth, Leith, Anstruther, Montrose, Stonehaven, Aberdeen, Peterhead, Fraserburgh, Banff, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, Wick, Orkney Isles, and Shetland Isles.

East Coast Herring Fishery
Seventeen East Coast Districts.

EYEMOUTH DISTRICT.

From Amble, in the county of Northumberland, to the east side of St Abb's Head, both inclusive, with Coquet Island, Holy Island, and the Farne Islands.

District Fishery Office—Berwick-on-Tweed.

The average number of boats which fished in Eyemouth district last year was 434, being about the same as in 1883. About 100 of them belonged to Cornwall. The fishing was the most abundant ever known in the district. It began with a few boats in the second week of June, and was fairly successful till the end of July. At that time the fleet had increased to upwards of 400 sail, and the prospects of the fishing became exceedingly encouraging, daily takes being got varying from 50 to 100 crans a boat, and as many as 120 crans were not unfrequently landed. This great prosperity continued for five weeks. The weather was exceptionally fine during the whole season, and the fishing went on with almost uninterrupted regularity. It was brought to a close on the second week of September, with a total catch of 84,112 crans, giving an average of 194 crans to each of the 434 boats, being an increase of 36,086 crans on the total fishing of 1883, and of 83 crans on the average per boat. Of the whole catch fully three-fourths were

Number of Boats fishing.
Progress of Fishing.
Its great prosperity.
Total and average Catch.

How disposed of. cured, and the remainder was sold to be used fresh. The number of barrels exported was 35,380, as against 7869 in the previous year.

Fishing Grounds. The fishing grounds extended from 3 to 35 miles off shore. There seemed to be large shoals of herrings spread over the coast during the whole season, and the quality of the fish was quite as good as the average of former years. During the height of the fishing 26 steam tugs were employed towing the boats at a cost of £1100 a week, and fully £4000 was paid for this purpose during the season.

Steam Tugs employed.

LEITH DISTRICT.

Boundary of District. From the west side of St Abb's Head, *inclusive*, westwards, and *including* all the south side of the Firth of Forth; and its north side to Buckhaven, *exclusive*.

District Fishery Office—Leith.

Summer Fishing. Particulars thereof. In Leith district there is both a summer and a winter herring fishery. Last year the former was prosecuted only from Dunbar and Newhaven, and it was fairly good. The average number of boats employed was about 30, and the average catch was 153 crans to each, as against 82 in 1883. The highest take was 84 crans, and the best week of the season yielded 1140 crans. The principal grounds fished lay 15 to 25 miles from land. The returns of the winter fishing were very satisfactory, and far exceeded the take in any winter during the last eleven years. The fishing grounds were quite different from those in summer, and were confined to the upper reaches of the Firth of Forth—from Inchkeith to off Limekilns. About 120 boats, using drift and circle or seine nets, were employed during the season.

Winter Fishing. Its prosperity. Grounds fished.

ANSTRUTHER DISTRICT.

Boundary of District. From Buckhaven to the south side of Tay, *both inclusive*.

District Fishery Office—Anstruther.

First-class Boats and Fishermen. There are 603 first-class decked boats belonging to Anstruther district, and 3869 fishermen, but with the exception that some of these boats took part in the winter herring fishery in the district most of them prosecuted the herring fishing elsewhere, and were spread over the stations from the Shetland Islands to Shields on the English coast.

Mostly fished elsewhere.

Summer Fishing. The summer herring fishing began about 20th July, but there only remained in the district a very meagre fleet of ill-equipped second-class boats to prosecute it. The total catch of the season amounted to 3836 crans, which were all taken on grounds lying from 15 to 60 miles seaward from the Island of May. The winter herring fishing was the most successful ever recorded in the district.

Details thereof. 239 boats were engaged in it, and it produced nearly 33,000 crans.

Winter fishing very successful. All the herrings were sent to the home markets either in a fresh state, bloated, or kippered. The best week of the season was that which ended 9th February, when 12,365 crans were brought on shore. During that week 800 waggon loads of herrings were sent off by rail, and 3400 telegrams in connection with the fishery were transmitted from the Anstruther post office. With such an

Its produce.

How disposed of.

Best week.

800 waggon loads and 3400 telegrams sent off in one week.

abundant capture, the markets became glutted, and prices were then as low as from 2s. to 5s. per cran, but during other weeks of the season the rates varied from 10s. 6d. to as high as £3. The herrings were all got close to the Island of May and the east coast of Fifa.

Prices per Cran.
Fishing grounds.

MONTROSE DISTRICT.

From the north side of Tay to Bervie, both inclusive.
District Fishery Office—Montrose.

Boundary of District.

Montrose district had 146 boats engaged in 1884, being 28 fewer than in the previous season. The fishing began about the second week of July, but it was attended with only a moderate degree of success till the beginning of August, when it improved. The great bulk of the season's catch, however, was got in the three weeks ending 2nd, 9th, and 16th August, which yielded averages per boat of 38, 57, and 44 crans respectively. The fishing was brought to a close on 13th September, with an average take of 184 crans per boat, as against 88 crans in the preceding year. The grounds principally fished lay from 5 to 50 miles off-shore. The winter herring fishing of this district was more abundant in 1884 than in any former year. It produced 2366 crans, as against 1529 crans in 1883, all of which were taken about the Tay and on the in-shore grounds.

Number of Boats engaged.
Progress of Fishing.
Best weeks.
Average take.
Grounds fished.
Winter Fishing very successful.

STONEHAVEN DISTRICT.

From Bervie, exclusive, to Skateraw, inclusive.
District Fishery Office—Stonehaven.

Boundary of District.

Stonehaven district had a fleet of 102 boats fishing in 1884, 11 of which belonged to Cornwall, as against 110 in 1883. The fishing commenced as usual about the second week of July, but it was only moderately successful until the beginning of August. During the first three weeks of that month the average takes per boat were 23, 41, and 38 crans respectively. Thereafter the fishing greatly fell off, and on 3rd September it was given up altogether. The highest aggregate catch of any one boat during the season was 275 crans, the lowest 49 crans, and the average of the whole fleet was 139 crans, as against 120 in 1883. The quality of the herrings was good until the middle of August; thereafter the takes were chiefly composed of spent and small inferior fish. About one half of the entire catch was got 30 to 70 miles at sea, and the remainder from 5 to 15 miles off-shore. In June, before the fishing commenced, large shoals of herring were seen from 5 to 100 miles from land, but it is supposed that the greater portion of them went to the Berwick and Northumberland coasts, where there was afterwards an unusually abundant fishing. The winter herring fishing is very limited in this district. Last season it yielded 600 crans, which were sold at prices varying from £2 to £5 a cran. In the winter of 1883, 200 crans were taken.

Number of Boats.
Progress of Fishing.
Highest, lowest, and average Catch.
Quality of Fish.
Grounds fished.
Large Shoals seen in June.
Winter Fishing.

ABERDEEN DISTRICT.

From Skateraw, exclusive, to Aberdeen, inclusive.
District Fishery Office—Aberdeen.

Boundary of District.

In the Aberdeen district 374 boats were employed last year—33

State of Fleet.

Fishing very
successful.
Details thereof.

of which were from England—as against 468 in 1883, showing a decrease of 93 boats. Notwithstanding this large diminution in the number of boats employed, the total catch of herrings in 1884 greatly exceeded that of the preceding year. The fishing was begun in June, but it was not attended with much success till July. The most productive week of the season was the one ending 9th August, which yielded for the fleet an average of 56 crans a boat. In that week heavy takes were got of 90, 100, 120 and 137 crans. The industry was brought to a close in the beginning of September. The principal grounds fished extended from 30 to 70 miles off-shore. Fogs and calms were experienced towards the end of July, which had the effect of delaying the return of some of the boats from sea, and many of their herrings were consequently deteriorated in value. Of these 4000 to 5000 crans were landed in very bad condition, some of which were only fit for manure. Three steam fishing boats fished from Aberdeen, but they were only partially successful—their takes being under the average of the other boats of that port. The season yielded an average of 176 crans per boat, as against 89 in 1883, and the gross number of barrels cured was 89,083, showing a rise of 37,255 barrels on the cure of the previous year.

Grounds
fished.
Fogs and
Calms delayed
some Boats.
Herrings
landed in bad
condition.
Steam Fishing
Boats.
Produce of
Season.

PETERHEAD DISTRICT.

Boundary of
District.

From Aberdeen to Rattray Head, *both exclusive.*
District Fishery Office—Peterhead.

Number of
Boats in Fleet.
Fishing best
ever recorded.

Immature
Herrings.
Difficulty in
disposing of
takes.

Agreement
with Curers.

Best weeks of
Season.

Great catch
landed at
Peterhead.
Weather.

Difficulty in
dealing with
daily takes.

Curing Vessels.

The Peterhead district had a fleet of 763 boats in 1884, being 13 more than in 1883. The fishing proved the most successful ever recorded there, and yielded the very high average of 240 crans a boat. The previous year's average was 155 crans. Fishing was begun much earlier than usual, and before the fishermen's engagements with curers were in operation, a large quantity of immature herrings was immediately captured. Difficulty was experienced in disposing of the fish, and for the best of them prices fell as low as 2s. a cran, while a large proportion of the most inferior takes were either thrown back into the sea or used for manure. The fishing continued abundant till the middle of July, at which time the curers had agreed to take the whole catch at 20s. a cran, besides paying the bounty money. The quality of the takes was then still inferior, but an improvement afterwards took place. In the weeks ending 2nd and 9th August, the heaviest fishing was made, and the fleet averaged for these two weeks, 45 and 57 crans respectively. On the 6th August 310 boats landed at Peterhead the extraordinary high average catch of 45 crans. The shoals were chiefly found from 15 to 60 miles off-shore. The weather was unusually fine all the season, with the exception that there were occasional fogs, which, together with some calms that took place, had the effect of sometimes detaining the boats at sea. On account of this, and of the heavy takes, great difficulty was frequently experienced in getting each day's catch satisfactorily dealt with. Three curing vessels fitted out for the deep sea fishing were employed during the season, and met with a fair amount of success.

There were cured on board of these vessels 1407 barrels of herrings, a considerable portion of which obtained the crown brand. The season closed about the middle of September. The gross number of barrels cured in the district amounted to 296,569, as against 182,590 in 1883, being an increase of 113,979 barrels.

Number of
Barrels cured.

FRASERBURGH DISTRICT.

From Rattray Head, *inclusive*, to Troup Head, *exclusive*.
District Fishery Office—Fraserburgh.

Boundary of
District.

The continued prosperity of the Shetland herring fishery had the effect last year, as in the three previous years, of attracting boats from the Fraserburgh district in increasing numbers, and its fleet showed in 1884 a further diminution of 99 boats. The number of boats engaged during these past four years was 1007 in 1881, 900 in 1882, 839 in 1883, and 740 in 1884. Notwithstanding, however, the further decrease in the boats employed in 1884, the fishing greatly exceeded that of any former year, and will long be remembered for its remarkable abundance; but unfortunately it contained a very large quantity of immature herrings or maties. The season opened about 1st July with unprecedented success—average takes varying from 15 to 30 crans a boat being landed daily. On 15th July, 650 boats had an average take of fully 30 crans; but owing to the greatness of this catch and to some of the boats being late in returning to harbour, upwards of 6000 crans had to be thrown overboard on the following morning, while 3000 crans were used for manure. The curers urged the fishermen to use larger meshed nets, and not to go to sea every night. Next day, however, a large number of the boats had takes varying from 80 to 130 crans, and the gross quantity of herrings captured was greater than ever, so that the fish-curers, coopers, and gutters were overwhelmed with the amount of work they had to face. Continued success attended the progress of the fishing till about the middle of September, when it was brought to a close. The average catch for each of the 740 boats was $278\frac{1}{2}$ crans, against $138\frac{1}{2}$ in 1883, but one of the boats had been so fortunate as to have taken 630 crans in eleven hauls. To the great loss of the fish-curers, the herrings, as has been already stated, were generally inferior in quality, probably not more than one-sixth being full fish. Dense shoals of herrings had been found all over the coast during the season, and the grounds fished extended from 5 to 65 miles off-shore. The weather was generally very fine and well suited for fishing. There were no less than 348,368 barrels cured, being an increase of $155,540\frac{1}{2}$ barrels on the number of 192,827 $\frac{1}{2}$ cured in 1883. A large quantity of the herrings were kippered for the home markets, and upwards of 334 tons were preserved in tins, chiefly for exportation. Unfortunately, however, of the season's catch about 10,000 crans only could be disposed of for manure.

More Boats go
to Shetland
than formerly.

Number em-
ployed in last
four years.

Season most
abundant ever
known.

Progress of
Fishing.

Herrings
thrown over-
board, and used
for manure.

Trade over-
whelmed with
work.

Average catch
of Boats.

Herrings
inferior.

Dense Shoals
all over coast.

Gross results
of season.

BANFF DISTRICT.

Boundary of District.

From Troup Head, *inclusive*, to Cullen, *exclusive*.
District Fishery Office—Macduff.

Number of Boats.

Average Catch.

Barrels cured.

A abundant fishing in July.

Quality of Herrings.

The Banff district had a fleet of 150 boats, being 32 less than in 1883, but the catch of 1884 was much greater than that of the previous year. It reached the high average of $210\frac{1}{2}$ crans a boat, against $117\frac{1}{2}$ crans in 1883. The total number of barrels cured was 40,787, while that of 1883 was 25,872 $\frac{1}{2}$, showing an increase last year of 14,914 $\frac{1}{2}$ barrels. Fishing operations began about the usual period—the second week of July, and that month was the best of the season, and yielded a greater catch than it had done in any former year. The fishing closed at the end of August. The quality of the herrings was generally poor—a large proportion being maties and small full fish. The grounds fished lay from 40 to 60 miles off-shore.

MORAY FIRTH DISTRICTS, embracing—

BUCKIE DISTRICT.

Boundary of District.

From Cullen to east side of Spey, *both inclusive*.
District Fishery Office—Buckie.

FINDHORN DISTRICT.

Boundary of District.

From west side of Spey to south side of Kessock Ferry, *both inclusive*.
District Fishery Office—Burghead.

CROMARTY DISTRICT.

Boundary of District.

From north side of Kessock Ferry to south side of Mickle Ferry, *both inclusive*.
District Fishery Office—Cromarty.

HELMSDALE DISTRICT.

Boundary of District.

From north side of Mickle Ferry to Dunbeath, *both inclusive*.
District Fishery Office—Helmsdale.

Aggregate Fleet.

Average Catches.

Fishing grounds.
Weather fine.
Barrels cured.Quality inferior.
Best boats fished elsewhere.

The Moray Firth districts, extending from Cullen to Dunbeath, had in 1884 an aggregate fleet of 303 boats engaged in fishing at home, being 9 fewer than in the preceding year. Most of these boats were old and of an inferior character, with inferior netting. The average season's catch per boat was $77\frac{1}{2}$ crans; in 1883 it was $72\frac{1}{2}$ crans. The averages of the different districts were—Buckie $120\frac{1}{2}$ crans, Findhorn $86\frac{1}{2}$ crans, Cromarty $40\frac{1}{2}$ crans, Helmsdale 63 crans. The in-shore fishing was of no importance. The productive grounds ranged from 15 to 30 miles seaward, and remarkably fine weather favoured the boats all the season. The gross quantity cured in the four districts was 34,720 barrels, as against 31,843 in the former year, showing an increase of 2877 barrels; but the herrings were usually small and of inferior quality. All the finest and best equipped boats belonging to the Moray Firth districts fish at other stations. Last year they had generally a most

successful season, more particularly those belonging to Buckie and Findhorn, each of which had an aggregate catch of from 200 to 600 crans. Had most successful season.

LYBSTER DISTRICT.

From Dunbeath, *exclusive*, to East Clyth, *inclusive*.
District Fishery Office—Lybster.

Boundary of District.

In Lybster district 119 boats were employed last year, being 29 fewer than in 1883, and 48 fewer than in 1882. Only about one-third of the boats belonging to the district are fully decked; the others are half decked, and generally old crafts. During the last twenty years the industry has not been in a prosperous state in the district. The fishing began last season as usual about the middle of July, and ended on 2nd September, with the poor average catch of $37\frac{1}{2}$ crans a boat, being a decrease of $73\frac{1}{2}$ crans on the average of the previous year. The barrels cured were 10,876 less than in 1883. The grounds fished last summer and autumn lay from 10 to 12 miles, and from 30 to 40 miles at sea. The winter fishing was prosecuted close in-shore. During most of the season the herrings were smaller than in former years, but in winter 1189 crans of large fine herrings were captured.

Number of Boats employed.

Industry not prosperous in District. Progress of Fishing.

Barrels cured.

Fishing Grounds. Quality of Herrings.

WICK DISTRICT.

From East Clyth, *exclusive*, to Cape Wrath, *inclusive*, including the island of Stroma in the Pentland Firth.

Boundary of District.

District Fishery Office—Wick.

Wick district had a fleet of 543 boats engaged in the fishing of 1884, showing an increase of 25 boats on the previous year. The average catch per boat was 190 crans. The number of barrels cured was 127,140, being 28,528 less than in 1883, but the cure of that year was the highest ever reached in the district. The fishing began sooner than usual, and before the middle of July it was attended with unprecedented success as to quantity, but the herrings taken were immature and of comparatively little value. Curers were unprepared for salting such a large catch at so early a period of the year, as in former seasons the enterprise had at that time scarcely commenced. The fishing continued remarkably abundant, and many takes were lauded varying from 40 to 140 crans. One yielded 150 crans, which was said to be the largest haul ever taken by any boat on the East Coast of Scotland. There were fogs and calms for about ten days in the earlier part of August, when the prospects of the fishing were at their best, which frequently prevented the boats from getting to sea. Had it not been for this the gross catch of the district would have been much larger. Scarcely any herrings were taken in-shore. The productive fishing grounds extended from 25 to 60 miles from land. Two establishments, with the necessary machinery, were erected at Wick last year for manufacturing manure from fish offal.

Fleet of Boats.

Average Catch and Barrels cured.

Opening of Fishing.

Very heavy Catches.

Largest take ever landed. Fogs and Calms.

Fishing Grounds.

ORKNEY DISTRICT.

The Orkney Islands; and Swona, in the Pentland Firth.
District Fishery Office—St Margaret's Hope.

Boundary of District.

Increased number of Boats.

In 1884 the Orkney district employed 290 boats, being an

increase of 85 on the preceding year. Of these boats 167 fished at Stronsay section, and 123 at St Margaret's Hope section. The fishing began about the middle of July with very encouraging success. The first week yielded an average of $42\frac{1}{2}$ crans a boat, but in the subsequent weeks the takes were smaller. A peculiar feature of the season was that the success of the different boats was much varied, their gross takes ranging from 20 crans each, up to as many as 500. As was to have been anticipated, when such heavy fishing was got by some boats, it occasionally happened that nets could not be hauled up owing to the weight of herrings which they contained, so that both nets and herrings were lost. The fishing closed on 6th September, with an average catch of 126 crans for each boat engaged. With the exception of the year 1883, when it was 181 crans, this was the highest average ever recorded in the district. The number of barrels cured was 48,824 against 46,372 in 1883. During part of the season the quality of the herrings was good, but a great portion of the whole season's take was composed of inferior fish. Fogs and calms more or less prevailed for about two weeks during the height of the season, and there were gales at different times, both of which had the effect of keeping the fishermen on shore. Owing to the increased number of boats employed, and the widely scattered stations in the district, it was found necessary to divide it into two sections—St Margaret's Hope and Stronsay; and this arrangement enabled the Board to supervise the fisheries with less difficulty than formerly.

SHETLAND DISTRICT.

Comprising the Shetland Isles; and Fair Isle and Foula Island.
District Fishery Office—Lerwick.

The returns of the Shetland district for the last few years show that very great progress has been made in the development of its fisheries. Last year 932 boats were employed, against 792 in 1883. Of this large fleet, 377 boats, including 45 old six-oared boats, belonged to the district. The remainder came from Caithness, Ross-shire, Moray Firth, Aberdeenshire, Firth of Forth, Argyllshire, Isle of Man, England, and Ireland. The trade, anticipating that there would be an abundant fishing in 1884, made great preparations to profit by it as far as possible. In the spring of that year, no fewer than 37 new curing stations were erected, and many of the old ones were enlarged and improved, involving a large expenditure, and greater quantities of barrels and salt were imported than usual. The number of curing premises in use during the season was 123. The number of fish-curers was 71, and it was estimated that altogether upwards of 12,000 persons were employed in the district in connection with the fishery. Notwithstanding such a great gathering of fishermen and other persons from many different places, it is gratifying to state that generally very good order was maintained throughout the season, both at sea and on shore. Fishing was begun about the middle of May—three weeks sooner than usual—and large catches of immature herrings were

landed during that month at Balta Sound and Ronasvøe. The early fishing was commenced on the west side of Shetland on 1st June. It was unproductive at first, but by the middle of that month takes of 50 to 70 crans were got. At some of the stations large quantities of herrings were then delivered, and the curers experienced great difficulty in getting one day's fish salted before next day's came to hand. About the second week of July the fishing was given up at the west side of Shetland, and the boats went round to the east side, and continued the fishing there. During the season, the herrings kept much further from land than in the preceding three years; and those caught on the west, or Atlantic side, of the district were matured and fit for curing two or three weeks earlier than those taken on the east side. Fogs, calms, and gales interrupted the fishing to a limited extent, but, upon the whole, the weather throughout the season was remarkably fine. On some parts of the coast dog-fish appeared in great numbers, and caused much damage to netting. At the beginning of the fishing the quality of the herrings was poor, but it greatly improved during the regular season, and the fish were then very much larger and better than those taken in the other East Coast districts. The aggregate catch of the district was the largest ever recorded there, and amounted to 208,000 crans, or 16,000 more than in the previous year, giving an average take to each of the 932 boats engaged of 223 crans. Of these boats, 628 fished in Lerwick section and 304 in Unst section, and the number of barrels cured was 177,253 in the former section, and 122,864 in the latter, making together a total for the district of 300,117 barrels, as against 256,487 in the previous year. One establishment, with the necessary machinery, was erected at Balta Sound last year for manufacturing manure from fish offal.

Its progress.

Difficulty in getting Fish cured.

Fishing grounds.

Weather.

Dog-fish.

Quality of Herrings.

Aggregate and average Catch.

Boats in each section.

Barrels cured.

SUMMARY OF EAST COAST HERRING FISHERY.

The returns of the herring fishery on the East Coast of Scotland for 1884, show the large increase, in twelve districts, on the returns of 1883 of 453,676 barrels cured, and a decrease in five districts of 45,531 barrels, resulting in a net increase of 408,145 barrels, in 1884. The districts which mainly contributed to this increase are—Eyemouth, Aberdeen, Peterhead, Fraserburgh, and Shetland; and the decrease was chiefly in the Wick and Lybster districts. It is, however, to be noted that Wick had a catch in 1883, which was unprecedentedly large. The Moray Firth stations also show a falling off, but this is in a great measure accounted for by their best boats having gone to fish at other places. The rapid development of the Shetland herring fishery continues to be one of the most striking features connected with the industry. In 1874, or ten years previous to the year now reported on, the fishing throughout these islands yielded only the small total cure of 1100 barrels, and the fleet did not then exceed 50 boats. In 1881, the number of barrels cured amounted to 59,586, and the fleet consisted of 276 boats. In 1884, no fewer than 300,117 barrels were cured, and the boats numbered 932, showing an increase on 1883 of 43,630 barrels cured, and of 140 fishing boats.

Increase of 408,145 Barrels in 1884.

Rapid development of the Fishery in Shetland.

Herring Fleet and Barrels cured in 1874, 1881, and 1884.

Increase in 1884 on 1883.

East Coast
Fishery of last
Fifty years.

The official returns of herrings cured on the whole of the East Coast for the last fifty years, on the average of each period of ten years, show a large and continuous increase. They are as follow :—

	Periods of Ten Years.	Yearly average of Barrels cured.
Yearly increase in periods of Ten years.	1835 to 1844 inclusive,	428,343
	1845 " 1854 "	495,879
	1855 " 1864 "	515,368
	1865 " 1874 "	602,375
	1875 " 1884 "	902,665
	Barrels cured in 1884,	1,456,050½.

Increase per
cent. in 1884
on 1883, and on
last 10, 25,
50 years.

The number of barrels cured in the year 1884, when compared with that of 1883, shows an increase of 38·9 per cent.; when compared with the average of the last 10 years, it shows an increase of 61·3 per cent.; of 25 years, 107·9 per cent.; and of 50 years, 147·2 per cent.

WEST COAST HERRING FISHERY.

Nine
West Coast
Districts.

The nine fishery districts on the west of Scotland are :—
Stornoway, Loch Broom, Loch Carron and Skye, Fort-William, Campbelltown, Inveraray, Rothesay, Greenock, and Ballantrae.

STORNOWAY DISTRICT

Boundary of
District.

The islands of Lewis, Harris, North Uist, Benbecula, South Uist, Barra, and the smaller islands within this range; also St Kilda.

District Fishery Office—Stornoway.

Fishing very
successful.
Fleet.
Barrels cured.

In Stornoway district, the fishing of 1884 was more successful than it has been for the previous thirteen years. A fleet of 1167 boats was employed, and the total quantity of barrels cured amounted to 116,010½, against 68,387½ in 1883, being an increase of 47,623½ barrels. Of the two sections into which the district is divided, Stornoway section had 712 boats, which made an average catch of 79 crans, and Barra section had 455 boats, whose average catch was 56½ crans.

Average
Catch.

Barra Section.

The fishing began at Barra section on 12th May, and closed on 21st June, with the exception that six native boats continued fishing for two weeks longer. The grounds fished were chiefly in the Minch, 15 to 20 miles off land, as little could be done on the Atlantic side of the island in consequence of stormy weather.

Ground
fished.

Stornoway
Section.

At Stornoway section the fishing began in April, and a large quantity of immature herrings were taken from that time up to the end of May. At Carloway, on the west side of Lewis, 9 boats were employed, and they landed on 25th April the large catch of 700 crans. The best week of the season was that ending 21st June, when 12,869 crans were brought on shore. About this time most of the boats belonging to other stations left for home, but 70 native boats continued to prosecute the fishing with success, and up to the middle of September their additional takes amounted to 10,000 crans of excellent herrings. The ground fished at

Large Catch at
Carloway.

Best Week.

Success of
Native Boats
after others
leave.
Ground fished.

Stornoway section in the early part of the season was from 10 to 20 miles off the Butt of Lewis: afterwards it was chiefly in the Minch. The quality of the herrings generally was not up to the standard of former years. Prices throughout the season were very irregular, varying from 5s. to 30s. and sometimes up to 40s. a cran. From Stornoway section, 6725 crans fresh or lightly salted, and 13,640 crans kippered, were sent to the home markets; and 59,532½ barrels of cured herrings were exported to the Continent. An establishment, with the necessary machinery, was erected at Stornoway last year for manufacturing manure from fish offal.

Quality of
Herrings.
Prices.

Crans sold
fresh and
kippered.
Barrels cured.

Manufacture of
Manure from
Offal.

LOCH BROOM DISTRICT.

From Capé Wrath to Diobaig, *both exclusive*; including the lochs and islands within this range of coast. Boundary of District.

District Fishery Office—Ullapool.

For several years past the herring fishery has been exceedingly unproductive in Loch Broom district, but the fishing of 1884 was a considerable improvement on that of 1883. It was prosecuted wholly in the lochs and inland waters by native boats, of which at one period of the season 200 were employed. The fishing produced 16,700 barrels cured, against 2474 in the preceding year, showing an increase of 14,226 barrels. Twelve curing vessels were fitted out for the fishery during the year, and they cured on board more than half of the herrings caught in the district. The quality of the herrings was very fair, but prices ranged as low as from 4s. to 14s. a cran, and on this account the fishing was not carried on with the same energy as it would otherwise have been.

Improved
Fishing.

Where
prosecuted.
Barrels cured.

Curing
Vessels.

Quality of
Herrings.

LOCH CARRON AND SKYE DISTRICT.

From Diobaig, *inclusive*, to Loch Nevis, *exclusive*; including the lochs and smaller islands within this range of coast; also the islands of Skye, Scalpa, Rasay, Rona, and Croulin. Boundary of District.

District Fishery Office—Broadford.

In Loch Carron and Skye district, herrings, in greater or less abundance, were taken in all the sea-lochs on the mainland, and in the waters round Skye and the adjoining islands. The fish were spread over nearly the whole district, but the shoals were not large in any locality. The greatest number of boats employed at one time was 385, and the average is given at 252. The season was a successful one, and takes of from 10 to 60 crans were brought on shore daily for several weeks. The best week was the second in September, when 1379 crans were landed. The largest takes were got at the Sounds of Scalpa, Rasay, and Rona. In Loch Hourn, where great shoals of herrings were found in 1882, the success was only partial. The prices of fresh herrings were lower than in any previous year, and ranged during the season from 5s. to 30s. a cran.

Herrings over
whole District.

Boats
employed.
Season success-
ful.

Progress of
Fishing.

Prices lowest
ever received.

Steamers engaged.
Barrels cured.
Curing Vessels.

Nine steamers were more or less engaged in carrying herrings to Oban and Glasgow for consumption in a fresh state. 17,538 barrels were cured, being an increase on 1883 of 7117 barrels. Of curing vessels cleared out for the fishery, 34 were entered outwards and 33 inwards, an increase on 1883 of 11 outwards and 8 inwards.

FORT-WILLIAM DISTRICT.

Boundary of District.

From Loch Nevis to Oban, *both inclusive*; including the Lochs within this range of coast; also the islands of Canna, Rum, Eig, Muck, Coll, Tyree, Iona, Mull, Lismore, Kerrera, and the smaller islands.

District Fishery Office—Oban.

Boats engaged.

Best Week.

Prices of Herring.

Half Catch sold fresh, remainder cured.

Places fished.

Curing Vessels.

In Fort-William district last year 240 boats were at one time employed in the fishing. The week ending 22nd November was the most successful of the season, and yielded 3000 crans. The prices of herrings varied greatly during the year, and ranged from 5s. to 80s. a cran. About one-half of the whole catch was sent by rail from Oban to various central markets for use in a fresh state. The remainder produced 7906½ barrels cured, being 2062 fewer than in the preceding year. The places chiefly fished were Loch Nevis, Loch Scridain, Arisaig, Moidart, Loch Linnhe, and Loch Buy; but herrings were found at nearly every station in the district. Eighteen curing vessels were fitted out for the fishery.

INVERARAY DISTRICT.

Boundary of District.

From Oban to Tayinloan, *both exclusive*; including the lochs and islands within this range of coast, and from Skipness Point and Ardlamont Point, *both exclusive*, for both sides of Lochfyne, to the head of the Loch.

District Fishery Office—Ardtrishaig.

Poor Fishing.

Its beginning and progress.

Number of Boats.
Nets used.

Earnings of Seine Net Fishermen.

Steamers buy Herrings.

Barrels cured.

Presence of Mackerel attributed cause of falling off of Fishing.

In 1884 the fishing of Inveraray district showed a large decrease on the catch of recent years; and the herrings taken were unusually small, and of poor quality. The fishing commenced on 1st May—a month earlier than usual—and it was carried on with little intermission till the middle of November. June was the best month of the season. The fleet consisted of 284 boats—one half of which used seine nets, and the other half drift nets. Great takes were got with the former during the early part of the season. A number of crews of eight men with two boats, using seine nets, earned in the week ending 21st June, from £300 to £400 each; and several crews each made in the season, up to that time, from £500 to £600. About 20 swift steamers attended the fleet at the fishing grounds in Lochfyne and Kilbrannan Sound, and purchased herrings, which they delivered at different railway stations and in Glasgow. The number of barrels cured was 19,648, showing a decrease on the previous year's cure of 29,407 barrels. Mackerel were found in great abundance in Lochfyne. To this the fishermen attributed to some extent the falling off in the herring fishing, believing that herrings always leave waters where mackerel lie.

CAMPBELTOWN DISTRICT.

From Tayinloan, *inclusive*, round the Mull of Cantyre to Skipness Point, *inclusive*; including the islands of Colonsay, Jura, Islay, Gigha, and Sanda. Boundary of District.
District Fishery Office—Campbeltown.

Although the season of 1884 was not so prosperous in Campbeltown district as that of 1883, it yielded about 10,000 barrels above the average of the last ten years. Of the total catch, 40,921 barrels were cured, against 49,089 in 1883. The fishing was prosecuted by a fleet of from 45 to 428 boats. It was begun in spring, and continued with varied success till December, when it was closed. About one half of the fleet used seine nets, and the remainder drift nets. The herrings taken were of fair average size, and generally of superior quality. Prices ranged during the season from 10s. to 80s. a cran. Fourteen steamers frequented the fishing ground, and purchased a large portion of the takes, for immediate dispatch to the home markets, to be used fresh.

Season less prosperous than 1883.
Barrels cured.
Fishing Fleet.
Quality and Prices of Herrings.
Steamers purchased Takes.

ROTHESAY DISTRICT.

From Ardlamont Point, *inclusive*, to Roseneath Point, *exclusive*; including the lochs within this range of coast; also Bute and Arran. Boundary of District.
District Fishery Office—Rothesay.

The fishing in Rothesay district in 1884 was light. The number of barrels cured was 4154, as against 3297 in 1883, showing an increase of 857 barrels. During most of the season the herrings were remarkably small and immature, and prices were consequently low—varying from 10s. to 40s. a cran. Nearly the whole catch was despatched to the local markets for immediate consumption. A large proportion of the boats belonging to this district prosecute the fishing at other places. Twelve curing vessels were fitted out for the herring fishery during the year.

Fishing light.
Barrels cured.
Herrings small and immature.
Prices low.
Boats fish at other places.
Curing Vessels.

GREENOCK DISTRICT.

From Glasgow, westwards, on the north side of the River Clyde, to Roseneath Point, *both inclusive*, including Gareloch; on the south and east side of the River and Firth of Clyde to Ayr, *exclusive*, including the Cumbraes. Boundary of District.
District Fishery Office—Greenock.

Greenock district shows by the returns of 1884 a gross catch of 5346½ crans, being 2300 crans more than in the preceding year. The fishing began in June, and continued till December, and at one time 68 boats were employed, but the best boats belonging to the district fished at other stations. Small takes were got early in the season at the four principal stations of Largs, Millport, Irvine, and Saltcoats. Comparatively few herrings appeared upon the coast until November, when good takes were obtained, some of them being as high as 25 crans. The quality of the herrings was rather inferior, and they only realised moderate prices.

Gross Catch.
Boats engaged.
Particulars of Fishing.
Quality and Prices.

BALLANTRAE DISTRICT.

Boundary of District.

From Ayr to Sark River, Solway Firth, both inclusive.
District Fishery Office—Girvan.

Both Winter and Summer Fishery.

Three modes of capturing Herrings.

Winter Fishing and its value.

Success dependent on Weather.

Boats kept on shore.

Nets destroyed.
Best week.

Prices of Herring.

Summer Fishing and its value.

Gross Catch.
How disposed of.

There is both a winter and a summer herring fishery at Ballantrae, but the former is the distinguishing feature of the district. Three modes of capturing herrings are adopted, namely, by drift-nets, seine-nets, and trammel-nets. The winter fishing was carried on last year from 1st January till the end of March. The number of boats employed was 443, and the total catch amounted to 14,564 crans, the estimated value of which was £43,692. In 1883, 400 boats were engaged; their gross catch was 24,575 crans, the value of which was about £80,000. The fishing being prosecuted on the exposed bank of Ballantrae, its prosperity is greatly dependent on the state of the weather. Last year was a very stormy one, and the drift-net fishermen had frequently to remain on shore, while some of the seine-net boats were only four or five times at sea during the entire season. One gale destroyed a large quantity of nets. The best takes were got in the week ending 5th March, when 257 boats landed 4776 crans. There was always an excellent demand for the herrings. The average price during the season was about £3 a cran, but prices ranged from 24s. up to as high as £6, 12s. 6d. a cran. In the summer fishing from 49 to 151 boats were employed, and the catch amounted to 5040 crans, the value of which was estimated at £9743. The gross catch of both the summer and winter fishing was 19,604 crans, and its estimated value £53,435. Of this catch, 3040 crans were kippered, and the remainder were sent either fresh or lightly salted to the home markets.

SUMMARY OF WEST COAST HERRING FISHERY.

Success of Fishing.

Barrels cured.

Increase in five districts.

Decrease in four.

High prices of Herrings caught in Inveraray and Ballantrae districts.

Disappearance of Herring attributed to presence of Mackerel.

The herring fishery on the West Coast of Scotland was more successful in 1884 than on the average of recent years. The gross number of barrels cured was 241,026½, being 19,519½ more than in 1883. Five of the nine districts, when compared with the preceding year, show a collective increase of 71,638½ barrels cured, and four a diminution of 52,119 barrels. The principal increase was in the districts of Stornoway and Loch Broom, and the decrease in those of Inveraray and Ballantrae. This falling off in these two districts is all the more to be regretted, as their herrings realise higher prices than those taken on any other parts of the West Coast, owing to the richness of their flavour, and to their being taken at a season of the year when herrings are scarce. For several years past herring shoals have ceased frequenting the upper reaches of Lochfyne, the reason of which, the fishermen allege, is that mackerel are very numerous there, and frighten the herrings away.

The official returns of all the herrings cured on the West Coast of Scotland for the last fifty years, on the average of each period of ten

years, exhibit a continuous large increase. The following table shows the particulars:—

Periods of Ten Years.	Yearly average of Barrels cured.	Yearly average increase in Barrels cured in periods of Ten years.
1835 to 1844 inclusive,	70,067	
1845 „ 1854 „	79,300	
1855 „ 1864 „	110,665	
1865 „ 1874 „	171,196	
1875 „ 1884 „	194,135	
Barrels cured in 1884,	241,026½	

The number of barrels cured in the year 1884, when compared with that of 1883, shows an increase of 8·8 per cent.; when compared with the average of the last ten years, it shows an increase of 24·1 per cent.; of 25 years, 46·7 per cent.; and of 50 years, 92·7 per cent.

Increase per cent. of year 1884 on 1883, and on average of last Ten, Twenty-five, and Fifty years.

SUMMARY OF HERRING FISHERY ON BOTH COASTS.

The following tabular statement gives the particulars of the increase or decrease in the herring fishery of 1884 in each of the twenty-six districts, as compared with that of 1883:—

The Twenty-six Fishery Districts.	Year 1883, Barrels cured.	Year 1884, Barrels cured.	Increase in 1884.	Decrease in 1884.	The Twenty-six Fishery Districts.
Eyemouth,	40,265	88,851	48,086	..	Increase and Decrease of Barrels cured in 1884, as compared with 1883, in each District.
Leith,	2,154½	5,487½	3,333½	...	
Anstruther,	5,215	11,050	5,835	...	
Montrose,	21,696½	39,175	17,478½	...	
Stonehaven,	15,749	18,995½	3,246½	...	
Aberdeen,	51,828	89,713	37,885	...	
Peterhead,	182,590	297,976	115,386	...	
Fraserburgh,	192,827½	348,368	155,540½	...	
Banff,	25,872½	40,787	14,914½	...	
Buckie,	15,530	21,419	5,889	...	
Findhorn,	3,922	3,096	...	826	
Cromarty,	1,373	1,039	...	334	
Helmsdale,	11,018	9,166	...	1,852	
Lybster,	19,338	5,347	...	13,991	
Wick,	155,668	127,140	...	28,528	
Orkney Isles,	46,372	48,824	2,452	...	
Shetland Isles,	256,487	300,117	43,630	...	
Stornoway,	68,387½	116,010½	47,623½	...	
Loch Broom,	2,474	16,700	14,226	...	
Loch Carron and Skye,	10,421	17,538	7,117	...	
Fort William,	9,968½	7,906½	...	2,062	
Campbeltown,	49,089	40,921	...	8,168	
Inveraray,	49,055	19,648	...	29,407	
Rothsay,	3,297	4,154	857	...	
Greenock,	2,314	4,129½	1,815½	...	
Ballantrae,	26,501	14,019	...	12,482	
Totals,	1,269,412½	1,697,077½	525,314½	97,650	Totals of Increase and Decrease.

These statistics show that the gross number of barrels cured in 1884 was greater than in 1883 by no less than 427,664½ barrels. Further, it is most gratifying to state that the official returns of

Increase on both coasts, of 1884 on 1883, and during last Fifty years.

cured herrings, on both the east and west coasts for the last 50 years, on the average of each period of ten years, exhibit a great and continuous increase. The following statement gives the particulars of this increase :—

Yearly Average increase in periods of Ten years.

Periods of Ten Years.	Average Number of Barrels Cured Yearly in each Period.	Increase in Average Number of Barrels Cured Yearly in each Period.	Increase per cent. in Average Number of Barrels Cured Yearly in each Period.
1835 to 1844 inclusive,	497,848	...	...
1845 „ 1854 „	575,131	77,283	15.5
1855 „ 1864 „	626,033	50,902	8.8
1865 „ 1874 „	773,575	147,542	23.6
1875 „ 1884 „	1,097,967	323,492	41.8
Barrels cured in 1884,		1,697,077½	

Increase per cent. of year 1884 on 1833, and on average of last Ten, Twenty-five, and Fifty years.

Great Development of Fishery since 1809.

The increasing productiveness of the herring fishery of Scotland, as shown by these statistics, is of a very striking character. The gross number of barrels cured in the year 1884, when compared with 1833, shows an increase of 33.6 per cent.; when compared with the average of the last ten years it shows an increase of 54.6 per cent.; of the last 25 years, 92.6 per cent.; and of the last 50 years, 137.7 per cent. The extraordinary development of the fishery becomes even more striking on its being contrasted with the first returns compiled by the former Fishery Board, in the year 1809, when the whole number of barrels cured was only 90,185½; whereas the number cured last year, as stated above, was 1,697,077½, or an increase of 1781.7 per cent.

HERRINGS CURED ON BOARD OF VESSELS AND ON SHORE.

Vessels; and Herrings cured on Board.

Table I. Appendix A, shows the number of vessels fitted out in Scotland last year for the herring fishery; the districts from which they were fitted out; their tonnage and the number of men; the quantity of netting, salt and empty barrels shipped; and the total number of barrels of white herrings cured on board; distinguishing those cured gutted from those cured ungutted.

Herrings cured on Shore.

Table II. Appendix A, shows the number of barrels of white herrings cured or salted in Scotland last year by fish-curers on shore, and the districts in which they were cured; distinguishing the herrings cured gutted from those cured ungutted.

Total of Herrings cured in Vessels and on Shore.

Table III. Appendix A, shows the total number of barrels of white herrings cured or salted in Scotland last year, both on board of vessels and on shore, distinguishing the herrings cured gutted from those cured ungutted. To this table is added a supplementary note, showing the number of barrels cured or salted last year on the West Coast of Scotland, as stated according to the districts where the herrings were caught.

Herrings cured on West Coast.

BRANDING OF HERRINGS.

Of the herrings cured last year, 653,425 barrels, after being examined by the Board's officers, were found entitled to the brand, being an increase on the previous year of 182,429½ barrels. The quantity branded would undoubtedly have been much greater had it not been that, in consequence of boats being frequently detained at sea by calms and fogs, the herrings when delivered were not sufficiently fresh to be properly cured. Such detention of boats was more frequent last year than in recent years, and rendered increased care necessary on the part of the officers in examining the herrings before granting the brand. It is due to the officers to say that in carrying out this important part of their duty, the Board has every reason to believe that they did so in the most careful manner as regards all the curers, and that no effort on their part was wanting to meet the demands for inspection with as little delay as possible.

Increase in
Barrels
Branded.

Herrings not
in good condi-
tion for Curing.
Increased care
by Officers
necessary.

How Officers
carried out the
work.

Table IV. Appendix A, shows the total number of barrels of white herrings which were branded in Scotland last year; and of the brandings in each district. To this table there is added a note showing the total number of barrels therein given, which were branded 'Full,' 'Maties,' or 'Spent'; and the total amount of fees collected.

Particulars of
Herrings
Branded.

The Board deems it of importance to call attention to the fact that the demand for branded herrings continues to increase. In 1859, the year when the fee of 4d. per barrel was first charged for branding, the number of barrels branded was 158,676. In 1869, or ten years thereafter, the number had increased to 244,522½; in 1879, or other ten years, it was 342,323; and last year the number had still further increased to 653,425. The amount received for brand fees has of course been proportionately becoming larger. In 1859, the year when the fee was first charged, it produced £2644, 12s.; in 1869, or ten years thereafter, it produced £4075, 7s. 6d.; in 1879, or other ten years, £5705, 7s. 8d.; and last year, £10,890, 8s. 4d. The great bulk of branded herrings are sent to the Continent of Europe, and what has now been stated affords most gratifying proof of the high and growing estimation in which the superior standard of cure required by the Board, before its brand is given, is there held; and such increasing demand for branded herrings is all the more striking, seeing that the Parliamentary Commission of Inquiry in 1846, on whose recommendation the brand fee was charged, estimated that it would realise only about £3500 a year.

Increasing
demand for
Branded
Herrings.

Increase in
Barrels
Branded.

Increase in
Brand Fees
received.

Bulk of
Branded
Herrings go to
Continent.
Estimation in
which Branded
Herrings are
there held.

It may be here mentioned, that the Board continues to do everything in its power to maintain the high character which the brand has earned. For this purpose the district officers are strictly enjoined, before granting it, to satisfy themselves that the herrings for which it is desired are, in respect of quality, selection, cure, and packing, conformable to the requirements of the Fishery Acts and the Board's regulations, and that the barrels are of the statutory size. And further, with a view to enhance still more the value of the brand in foreign countries, and to raise the

Efforts of
Board to
maintain high
character of
Brand.

Instructions to
Officers regard-
ing this.

character of the Scottish herring fishery there, the Board's officers are instructed to see, as far as possible, that no damaged branded barrel of herrings is shipped, until either the damage is repaired or the brand marks are removed from it.

FRAUDULENT BRANDING OF HERRINGS.

Proceedings in case. The proceedings narrated in the Board's Report of last year, regarding a colourable imitation of the official crown brand having been fraudulently used in branding half barrels of cured herrings in Stettin, which were under the legal size, and contained herrings of so inferior a quality as to be unfit for the brand, have been of a very protracted nature, and are not yet brought to a conclusion, owing to delays which have arisen consequent upon the case having had to be prosecuted abroad. There is, however, every reason to believe that a conviction against the offending party or parties will in the end be obtained. The Board has to express its obligations to you, Sir, as well as to Earl Granville, and to Mr Dundas, Her Majesty's Consul at Stettin, for the aid given to it in this important matter; and as the proceedings in the case have been made public on the Continent, most beneficial results are expected to arise from the prosecution having been instituted, by showing the determination which exists in this country to maintain the integrity of the official brand.

Their protracted nature.

Expectation of Conviction.

Thanks for Aid given.

Beneficial results of prosecution.

FALSIFYING DATES OF CURE ON BARRELS OF HERRINGS PRESENTED FOR THE BRAND.

Falsifying Dates of Cure. A case of falsifying the original date of cure upon barrels presented for the official brand was reported to the Board as having taken place at Peterhead. A curer there presented for the brand 18 barrels of herrings, from which the original date of cure had been erased and another date substituted. The barrels were seized by the Board's officer, and upon the matter being investigated, it was found that, unknown to the curer, the alteration of date had been made by one of his workmen. In these circumstances, and as the curer expressed his regret for what had occurred, the Board, in virtue of its statutory powers, agreed to restore the barrels of herrings on his paying a small fine which it fixed, with a condition that if he should again present the herrings to be branded, the original date of cure was to be restored. These terms were complied with, and no legal proceedings were instituted in the case.

Seizure of the Herrings.

Dates found to have been altered by a workman.

Regret of party. Fine imposed.

ILLEGAL HERRING BARRELS.

Discovery of Illegal Herring Barrels. In the early part of the year now reported on, it was discovered that a large number of herring barrels were being made by a firm of fish-curers at Fraserburgh, of a size under that prescribed by the statute 55 Geo. III. cap. 94. Some of these barrels were two gallons under the legal size, which is 32 gallons English wine measure. As it was necessary that the statutory capacity should be maintained in the interests of the fishery trade, as well as of the general community, the Board determined that the use of such

illegal barrels should not be permitted, and its officer was instructed to warn the firm in question that if they were filled with cured herrings, the barrels and the herrings would be seized, and proceedings taken to sell them for the benefit of the Crown. In defiance, however, of this warning, the firm in question shipped a number of undersized empty barrels to Stornoway and Barra, where they were packed with cured herrings. Seven of these barrels were seized at Stornoway, and after trial before the Sheriff there, at the instance of the Board's officer and the Procurator-Fiscal, one of them was condemned as illegal—the charge in regard to the others having failed in consequence of the insufficiency of the evidence brought forward by the officer. An appeal against the decision of the Sheriff regarding the one barrel was taken to the High Court of Justiciary, but the judges there unanimously confirmed the Sheriff's decision. They held that although the provisions of the statute to secure uniformity of measures, and the honesty of the trade, arose out of the bounty given by Government for the encouragement of the herring fishing which had long been abolished, the provision that the barrel shall be of a certain standard was still in force, and the appellant had been rightly convicted. The case is reported under date 15th July 1884, 11 *Rettie*, Justiciary, p. 57.

A number of barrels, filled with cured herrings, belonging to the same firm were also seized by the Board's officer at Barra, and the broad arrow put upon them. Several of these barrels were afterwards surreptitiously removed during the night, but the officer retained 17, and instituted proceedings with regard to them before the Sheriff at Lochmaddy. 107 barrels were afterwards seized at Leith, part, it was supposed, of those which had been surreptitiously removed from Barra, and steps were taken for their condemnation before the Sheriff of Edinburgh. Judgment, however, in the first action having now been given by the Court of Appeal in favour of the Board, the offending firm, through their agent, and with the view of stopping all further legal proceedings, expressed their willingness to agree to terms proposed by the Board. These terms were, that the barrels of herrings which had been seized at Leith, and any other undersized barrels of herrings seized at Barra, should be repacked by the firm in proper barrels (the undersized barrels to be broken up) and thereafter sold for the benefit of the Crown; that the firm should pay the legal expenses incurred by the Board in prosecuting the case, unless the consent of the Lords of the Treasury was obtained for their being met out of the proceeds of the sale of the herrings; and that any undersized barrels in the possession of the firm should either be destroyed or enlarged to the statutory size at the sight of the Board's officer. The Treasury, upon an application being made to them, declined to allow the law expenses incurred by the Board to be deducted from the proceeds of sale, and directed that the firm should be called on to pay the amount thereof. The whole matter has now been settled accordingly.

Besides the seizures above mentioned, the Board was under the necessity of detaining from fish-curers at Buckie and in Shetland a number of barrels packed with cured herrings which were also

Necessity for maintaining the standard size.

Warning to Curers.

Seizure at Stornoway and trial before Sheriff. One barrel condemned.

Case appealed.

Appeal dismissed.

Herrings seized at Barra and part surreptitiously removed.

Seizure of 107 barrels at Leith.

Application to Sheriff.

Firm willing to agree to terms of Board.

Herrings to be sold for benefit of the Crown.

Payment of Board's legal Expenses.

Other illegal Barrels to be destroyed or made Statutory size.

Treasury's decision as to Expenses.

Settlement of matter. Other seizures of illegal Barrels.

Fraud not
intended.
Regret of the
Parties.

Fine imposed
and Illegal
Barrels to be
destroyed or
enlarged.

Instructions to
Officers.

found to be under the legal size. Upon investigating these cases however, it appeared that they arose rather from carelessness on the part of the coopers employed by the curers in making the barrels, than from any fraudulent intention on their part, and upon the curers expressing regret for having thus unintentionally violated the law, the Board, under the authority of the statute 55 Geo. III. cap. 94, resolved to release the barrels and herrings on payment of a fine by the parties, and upon their agreeing to have the barrels either enlarged to the proper size, or destroyed at the sight of the Board's officers. These conditions having been agreed to, no prosecution was instituted.

On the conclusion of the legal proceedings above narrated, the Board issued instructions to its officers to explain to the curers in their respective districts the provisions of the statute bearing upon the use of undersized barrels, and also to inform them of the decision of the Court of Appeal in this case, and to exercise increased vigilance in seeing that no barrels under the statutory size were used for the packing of cured herrings.

EXPORTATION OF HERRINGS.

Quantity
Exported in
1884 largest
on record.

The total quantity of cured herrings exported in 1884 amounted to 1,185,220½ barrels, being an increase on the previous year of 294,460 barrels, and the largest exportation of cured herrings from Scotland on record.

From the following table it will be seen that Germany and other places on the Continent got 285,312 barrels more than in the previous year:—

Barrels of Cured Herrings Exported.

Exports of
1883 and 1884
compared.

Years.	To Ireland.	To the Continent.	To Places out of Europe.	Total Exported.
1883,	25,870	863,644½	1,246	890,760½
1884,	35,299½	1,148,956½	964½	1,185,220½
Increase in 1884, . .	9,429½	285,312	...	294,460
Decrease in 1884, . .	...	...	281½	...

Particulars of
Barrels
Exported.

Table V. Appendix A, shows the total number of barrels of white herrings exported from Scotland last year; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and distinguishing also herrings cured gutted from herrings cured ungutted, and herrings bung-packed from herrings repacked. To this table is appended a supplementary note showing the ports or places on the Continent to which the herrings were exported; and the total quantities exported.

Places to which
Exported.

Table VI. Appendix A, gives an abstract of the total quantity

of white herrings cured, branded, and exported, year by year, in so far as brought under the cognizance of the fishery officers, from 1st June 1809 to 31st December 1884; distinguishing the export to Ireland, to the Continent, and to places out of Europe.

Yearly totals of
Herrings,
1809-1884.

WINTER HERRING FISHERY.

The Winter Herring Fishery is usually prosecuted in January, February, and March; but last season, as in the preceding one, it was begun at the Leith and Anstruther stations two months earlier. It is carried on to a greater or less extent in the districts of Leith, Anstruther, Montrose, Stonehaven, Buckie, Findhorn, Cromarty, Helmsdale, Lybster, and Wick on the east coast, and at Ballantrae on the west coast, at which place it is of considerable importance. It is also occasionally prosecuted at most of the other stations on the west coast. Winter herrings were more abundant in the Firth of Forth last season than at any former period, in as far as the fishermen remembered, and shoals were found in all its upper reaches from Inchkeith to off Limekilns. At Anstruther, the gross takes amounted to 32,843 crans, being more than double the average of the last twenty-five years; and the catch at the Leith stations exceeded that of any catch of the last eleven years. At Ballantrae, however, while there were good prospects of success at the opening of the fishing, it proved less productive than in either of the two preceding years owing to stormy weather being more or less prevalent during its progress, and frequently preventing the boats from going to sea. But, altogether, the gross fishing at the different stations was greater than in any former season. On the other hand, the prices received for the herrings were very low. Those got at Anstruther were scarcely one half of what were realised in 1883.

Months when
prosecuted.

Districts
Fished.

Herrings
abundant in
Firth of Forth.

Large catch at
Anstruther
and Leith
Stations.

Ballantrae
Fishing
interrupted by
Storms.

Gross Fishing
best ever
yielded.

Prices very
low.

COD, LING, AND HAKE FISHERY.

The returns of the Cod, Ling, and Hake Fishery of 1884 show an increase of 4170½ cwts. in the quantity cured dried, and a decrease of 1402½ barrels cured in pickle, compared with the produce of the previous year. The season may be considered as having been a successful one, more especially when it is borne in mind that a much greater quantity of these fish is now despatched in a fresh state to the various home markets than in former years. The quantity cured dried in the past year, when compared with the average of the last forty years, shows an increase of 5116 cwts., equal to 4·2 per cent.; and the quantity exported last year shows the large increase of 11,707½ cwts. on the average exportation of the last forty years, being equal to 26 per cent.

Returns of 1884
compared with
1883.

Season fairly
successful.

Increase on
average of last
Forty years.

The districts of Shetland, Orkney, and Stornoway yielded more than two-thirds of the gross quantity cured at all the stations in Scotland. Shetland alone yielded nearly one half. There seems to be abundance of cod, ling, and hake on some of the grounds where they were captured, especially in the seas around Shetland and the Orkney Islands and the Outer Hebrides; but in consequence of the great success of the herring fishery in late years, and of its having

Most produc-
tive Districts.

Cod, Ling,
and Hake
Fishing less
profitable than
Herring.

recently proved very remunerative to the fishermen, the cod and ling fishery is not receiving so much attention as it would otherwise have done.

Faroe and
Iceland
Fishery.

There were only 13 vessels fitted out in Shetland for the fishery in 1884. Six of these went to Faroe and Iceland, and the other seven were merely employed for a few months in summer fishing at home. At one time, this branch of the fishing industry was a very important one in Shetland. Nine years ago, as many as 53 vessels were engaged in its prosecution.

The total quantities of cod, ling and hake cured and exported in 1883 and 1884 respectively, are—

Total Quantities of Cod, Ling and Hake Cured and Exported.

Cod, Ling and
Hake cured
and Exported
in 1883 and
1884.

Cured.			Exported all Cured Dried.			
Years.	Dried.	In Pickle.	To Ireland.	To the Con- tinent.	To Places out of Europe.	Total.
	Cwts.	Barrels.	Cwts.	Cwts.	Cwts.	Cwts.
1883,	120,335½	7,310	36,666½	17,123	2,736	56,525½
1884,	124,506½	5,907½	35,126½	11,633	9,956½	56,716½
Increase in 1884, . .	4,170½	...	...	...	7,220½	190½
Decrease in 1884, . .	...	1,402½	1,540	5,490	...	...

The decreased exports to the Continent were owing to there having been a smaller demand than formerly in the Spanish markets, regular supplies having been sent there over land from France. This led to an increase in the quantity sent to places out of Europe.

Cod, Ling,
and Hake
cured on Board
of Vessels.

Table I. Appendix B, shows the number of vessels fitted out in Scotland last year for the cod and ling fishery; the districts from which they were fitted out; the tonnage of the vessels; and the number of men; also the quantity of cod, ling, and hake cured on board.

Cod, Ling,
and Hake
cured on
Shore.

Table II. Appendix B, shows the total quantity of cod, ling, and hake taken at the cod and ling fishery in Scotland last year by open boats, and cured on shore, distinguishing the fish cured dried and the fish cured in pickle; and distinguishing also the districts in which they were cured.

Total of Cod,
Ling, and
Hake cured
on Board of
Vessels and on
Shore.

Table III. Appendix B, shows by districts the total quantity of cod, ling, and hake taken, both by vessels and by open boats, at the cod and ling fishery in Scotland, and cured last year; distinguishing the fish cured dried and the fish cured in pickle.

Cod, Ling, and
Hake Exported.

Table IV. Appendix B, shows the total quantity of cod, ling, and hake exported from Scotland last year; the quantities thereof

exported from different districts; distinguishing the export to Ireland, to the Continent, and to places out of Europe; and also whether cured dried or cured in pickle.

Table V. Appendix B, gives an abstract of the total quantity of cod, ling, and hake cured, punched, or branded, and exported year by year, *in so far as brought under the cognizance of the fishery officers*, from 10th October 1820, when the system for the encouragement and improvement of the cod and ling fishery commenced, to 31st December 1884.

Yearly Totals of Cod, Ling, and Hake Cured and Exported, 1820-1884.

FISH SOLD FRESH.

The former Fishery Board collected and published each year statistics of the quantities of herring, cod, ling, and hake which were *cured* in Scotland. This Board since its constitution has adopted the same course, and corresponding returns are embraced in this, and in its two preceding Annual Reports laid before Parliament.

Former Board collected Statistics of Fish Cured.

The Act under which the present Board is constituted directs that its Annual Reports shall contain a statistical account of the fisheries of Scotland, thus requiring it to make returns of the quantities of the different kinds of white fish which are caught and sold *fresh*, as well as those which are *cured*, and also of shell-fish.

New Board to make Returns in addition of Fish sold Fresh.

As soon as the necessary arrangements could be made, the Board addressed itself to this new duty. The work was begun on 1st April 1883, and thereafter regularly carried on, and there were inserted in the Board's last Annual Report the required additional statistics for one year beginning at that date. As, however, all the other returns included in its Reports are made up for the different years as ending on 31st December, the Board has deemed it desirable that a like course should be adopted as regards these new statistics, and in this way they are given in the present Report—namely, for the complete year of 1884.

Work begun on 1st April 1883. Years for which Returns are made.

These statistics will be found in Appendix C. It may be here stated that they have been compiled from returns collected by the Board's officers of the fish caught in the twenty-six districts into which the coasts of Scotland are divided for fishery purposes, assisted by a number of correspondents spread over the districts to whom a payment is made out of money provided by Parliament. The Board has no statutory power to compel parties who may possess it to give the necessary information, and the officers have had considerable difficulty in collecting the particulars required, and occasionally have been refused any information whatever; but, altogether, the Board considers the result as satisfactory and reliable as could have been reasonably expected in the circumstances.

Plan adopted in collecting Statistics.

Result fairly satisfactory.

The Appendix shows the total quantities of the different kinds of white and shell-fish taken, with their estimated values, but excluding those herring, cod, ling, and hake accounted for as *cured* in Appendices A and B, and it also gives the respective quantities taken in each of the twenty-six districts, with their estimated values.

Particulars of Statistics collected.

It will also be seen from the Appendix that the most important of the white fish taken and sold fresh, as regards quantity and value,

Quantities and Values of White Fish sold Fresh. is the haddock. 464,049 cwts. of haddocks were taken last year, the estimated value of which was £300,712; of the herring 138,219 crans were taken, or about 414,657 cwts., valued at £150,720; of the cod, 144,265 cwts., valued at £78,947; of the flounder, 72,758 cwts., valued at £47,723; and of the whiting, 71,507 cwts., valued at £32,808. The total estimated value of these white fish, and of the others enumerated in the returns, amounts to £716,295 for the year, and their gross weight to 1,494,042 cwts. As to shell-fish—of mussels, there were 249,348 cwts. taken, valued at £16,062; of crabs, 41,473 cwts, valued at £23,799; of lobsters, 727,174, valued at £29,942; and of oysters, 5176 hundreds, valued at £2174. The estimated value of these and the other shell-fish enumerated in the returns being £80,939, while the gross total value of the white fish and the shell-fish was estimated to be £797,234.*

Of Mussels, Crabs, Lobsters, and Oysters.

Comparison with any previous year not possible.

As statistics of these fisheries have never been collected before, no comparison can be made between the amount of fish taken and sold fresh last year, and that of any former one, but it is believed that the gross yield of 1884 was greater than the average of recent years.

Best Districts for Haddocks, Herrings, Cod, and Whittings.

The haddock fishing was successful, but it produced less than the unusually abundant year of 1883. The best takes of this fish were got in the districts of Eyemouth, Leith, Anstruther, Montrose, Aberdeen, Banff, and Buckie; of herrings, which were used in a fresh state, the largest quantities were taken in Eyemouth, Leith, and Anstruther districts; of cod, the largest quantities were taken in Eyemouth, Leith, Anstruther, Buckie, and Wick districts; of flounders, in Eyemouth, Leith, Aberdeen, Banff, and Findhorn districts; and of whittings, in Eyemouth, Leith, and Aberdeen districts. The sprat fishing was entirely confined to the upper reaches of the Moray Firth, the Firth of Forth, and the Firth of Tay. The catch of 1884 was much above the average, but the fishing was not prosecuted with much energy, as the bulk of the takes, owing to want of demand, could only be sold for manure. During the past year, 9660 cwts. of halibut were sent from Shetland in ice to the English markets, and a quantity was also sent to France.

Sprat Fishing.

Much above average. Bulk sold for Manure.

Best Districts for Mussels, Crabs, Lobsters, and Oysters.

Of shell-fish—mussels were taken last year in greatest abundance in Leith, Anstruther, Montrose, Cromarty, and Greenock districts; crabs, in Eyemouth and Leith districts; lobsters, in Eyemouth, Wick, Orkney Isles, Stornoway, Loch Broom, Loch Carron and Skye, Fort-William, and Campbeltown districts; but in 1884 nearly one-half of the total quantity of lobsters taken was got in the district of Stornoway. Oysters were chiefly taken in the districts of Leith, Cromarty, and Ballantrae.

BEAM TRAWLING.

Increase in Beam Trawling. Kinds of Fish taken.

Beam Trawling was prosecuted during 1884 to a much greater extent than formerly, and with a very fair amount of success, more especially by steam trawlers. A large quantity of fish consisting of cod, ling, haddock, whiting, halibut, turbot, skate, sole, plaice,

* For the total estimated value of the Fisheries of Scotland, amounting to £3,351,349, 12s. 3d., see page lxx.

flounders, and various other kinds of food-fishes was landed by trawl vessels. The takes upon the East Coast were usually delivered at Berwick, Eyemouth, Newhaven, Granton, Montrose, Aberdeen, and Wick; and those on the West Coast at Stranraer and Ayr, but beam trawling is not extensively prosecuted on the latter coast. Speaking generally, the trawlers obtained very good prices for their fish.

The Royal Commission which was appointed to inquire into the whole matter of beam trawling has recently issued an instructive Report, accompanied by a large body of evidence on this most important and extremely difficult subject. Shortly after the Commission was appointed the Board collected at its request, through the fishery officers, a considerable amount of information relating to the matter. It may be further stated that the Commissioners having asked that some one on behalf of the Board should give his views on certain specified subjects connected with the inquiry, Professor Cossar Ewart, M.D., one of our number, and Convener of the Scientific Investigation Committee, appeared before the Commissioners in London, and gave evidence at considerable length. The Commission also wished to have the opinion of the Board on some points connected with Marine Police, but as this is specially adverted to in what is stated on that subject (see page xlv.), it is unnecessary here again to refer to it.

Where delivered.

Royal Commission.
Issued Report.

Board collected Information for Commission.

Member of Board gave Evidence before it.

Opinion of Board on Marine Police.

BOATS AND VESSELS.

Table I. Appendix D, gives an account of the number of boats, Fishing Boats. decked and undecked, *irrespective* of the places to which they belong, employed in the herring fishery of Scotland, in the season of 1884, in a selected week for each district; with the number of Boats employed in Herring Fishery in selected week. fishermen and boys by whom they were manned; of coopers, gutters, packers, and labourers employed at the said fishery in the week so selected; and the total number of all such fishermen and other persons so employed.

The following table shows the number of boats, decked and undecked, and beam trawl vessels employed in the herring and other sea fisheries of Scotland; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed, in the years 1883 and 1884:—

Years.	Fishing Boats. and Beam Trawl Vessels	Fishermen and Boys.	Fish-curers.	Coopers.	Other Persons (Estimated).
1883,	15,294	49,722	1,031	2,736	47,522
1884,	15,445	49,860	1,062	2,809	48,832
Increase in 1884, .	151	138	31	73	1,310

Increase in 1884 on 1883.

Increase in
Boats, Fisher-
men, &c.,
continuous.

In connection with the above statistics it may be here noted, that, year after year, the number of boats, beam trawl vessels, and persons employed in connection with the sea fisheries continues to increase, thus showing a progressive development of the fishing industry.

Capital em-
ployed in 1883
and 1884.

The amount of capital employed last year in boats, nets, and beam trawl vessels, was much greater than in 1883. The particulars of this increase are exhibited in the following table:—

Years.	Values (estimated)—			
	Boats and Beam Trawl Vessels.	Nets.	Lines.	Total.
1883, . . .	£780,361	£753,760	£120,039	£1,654,160
1884, . . .	902,197	783,589	117,100	1,802,886
Increase in 1884, .	£121,836	£29,829	...	£148,726
Decrease in 1884, .	...	...	£2,939	...

Increase and
Decrease in
1884.

Cause of
Increase in
Capital.

The large increase in 1884, shown above, was chiefly due, as in the preceding year, to the additional capital invested in the large class of fishing boats and beam trawl vessels, which are now so extensively used, with their more expensive equipment and fishing material. The decrease in the value of lines has been caused by a great number of line fishermen having abandoned that mode of fishing, and embarked in the herring fishery.

Cause of
Decrease in
Lines.

Details of
Boats,
Vessels, &c.,
and Capital
employed.

Table II. Appendix D, shows the number and tonnage of boats, decked and undecked, and beam trawl vessels, employed in the herring and other sea fisheries of Scotland last year, with the districts to which they belonged; the number of fishermen and boys by whom they were manned; the number of fish-curers, coopers, and other persons employed; with the estimated value of boats, beam trawl vessels, nets, and lines.

Tonnage of
Shipping and
number of Sea-
men engaged.

Table III. Appendix D, shows the tonnage of shipping and the number of seamen engaged in the trade of the herring and cod, ling, and hake fisheries of Scotland, last year, distinguishing those employed in importing stave wood, hoops, and salt, in carrying herrings or cod-fish coastwise, or exporting them abroad; and distinguishing British from foreign tonnage and men.

Tonnage of
Boats and
Vessels and
Persons em-
ployed.

The total tonnage of boats and vessels, and the number of persons employed in the herring, cod, ling, and other sea fisheries of

Scotland in 1884, also show an increase on those of 1883. The particulars are—

ABSTRACT.	Total Tonnage of Boats, Vessels, and number of Persons Employed.			
	British.		Foreign.	
Years.	Tons.	Persons.	Tons.	Persons.
1883, . . .	282,712	111,038	46,780	2,484
1884, . . .	315,914½	114,337	74,817	3,739
Increase in 1884, .	33,202½	3,299	28,037	1,255
				Increase of Tonnage and

Table IV. Appendix D, gives abstract accounts of the tonnage of vessels and number of men; the tonnage of boats and number of fishermen and boys; and the number of other persons employed in the herring, cod, ling, and hake, and other sea fisheries of Scotland last year.

Table V. Appendix D, shows the number of lives lost in connection with the sea fisheries of Scotland; the number of boats totally wrecked, and value thereof; the number of boats damaged, and amount of damage; and the loss on nets and other fishing material lost or damaged, last year.

REGISTRATION OF BOATS.

By the Sea Fisheries Acts 1868 and 1883, and relative Orders in Council, British sea fishing boats are required to be registered, lettered, and numbered. The number of applications made to the Board's officers for certificates of registration during the year 1884 amounted to 900; the number of certificates issued 899; and the number examined and indorsed by the Board's officers 5433; showing a decrease from last year of 63 in the number of applications to register; of 59 in the number of certificates issued; but an increase of 271 in the number of certificates examined and indorsed. The number of boats detained, for contravention of the regulations in regard to lettering and numbering in 1884, was 275, being a decrease from 1883 of 144. This decrease has arisen to a great extent from the notice which was issued last year, under the authority of the Board of Trade, calling the attention of all owners and masters of sea fishing boats to the provisions of the Sea Fisheries Act of 1883, relating to this subject.

BOAT BUILDING.

Owing to the continued development of the Scottish fisheries, boat builders received a considerable number of orders for newboats in the course of 1884; and as fishing is now most successfully prosecuted at a much greater distance from land than formerly, those chiefly in demand are of a large size. The fishing boats built in 1884 measured from 44 to 60 feet of keel. A number of steam trawl vessels were also built during last year, and a good many steam line boats.

MARINE POLICE.

Circulation of
Sea Fisheries
Act, 1883.

Attention of
Masters and
Owners of
Boats directed
thereto.

Commissioners
appointed to
make inquiry
relative to the
Act.

Interview with
these Gentle-
men.

Particulars
supplied.

Officers in-
structed to
give them
information.

Trawling Com-
mission asked
opinion of
Board as to
Marine Police.

Referred to
Board's
Reports on the
subject.

Insufficient
experience of
Board to frame
Regulations for
Trawlers.

Reasons thereof
explained.

Proposed that
the Board
should have
power to make
Regulations.

Former Board
had such a
power as
regards
Herrings.

The Sea Fisheries Act, 1883, which came into operation last year, was circulated among the Board's officers, along with a placard issued by the Board of Trade, directing the attention of masters and owners of fishing boats to the provisions thereof, and to the penalties for their non-observance.

In reference to this matter, the Board has to report that, in the beginning of the past year, the Lords of the Admiralty and the Board of Trade appointed Rear-Admiral Gordon Douglas and Mr H. Noel Malan (then superintendent of Mercantile Marine at Grimsby), to conduct a joint inquiry respecting the measures to be adopted for giving effect to the above Act, and the North Sea Fisheries Convention. These gentlemen waited on the Board, when it took the opportunity of pointing out to them the great importance of efficient superintendence at sea, and upon their application it furnished them with such particulars on the subject as it possessed, and also directed its officers at the different stations to supply them with every information in their power relative to the fisheries in their districts. But their Report, if they have made it, has not been as yet communicated to this Board.

Since the passing of the above Act, the Trawling Commission asked the opinion of the Board as to the existing arrangements of marine police, and whether it would be possible to make them in any way more effectual with the view of reducing the damage done by steam trawlers to the nets and lines of fishermen. In reply, the Board stated that it had made certain suggestions in regard to this subject in a Report on the Fishery Acts and Regulations (pp. 1 to 19) addressed to you on 24th May 1883, which Report was subsequently presented to Parliament, and that the existing arrangements of marine police for maintaining order among the fishermen were also discussed in its Second Annual Report, dated 2nd June 1884 (p. lvii.) which was afterwards presented to Parliament, to both of which Reports the attention of the Trawling Commission was respectfully requested.

The Board has not yet had sufficient experience of the new mode of fishing by steam trawlers to enable it to frame a code of regulations so precise and complete as to be worthy of the sanction of an Act of Parliament. Any such code embodied in an Act of Parliament would be liable to two objections—1st, the risk of its not being framed in terms sufficient to meet the evils which should be guarded against; and 2nd, the impossibility of effecting, without another statute, any changes which longer experience might suggest. The Board, therefore, ventured to propose to the Trawling Commission, that as an administrative body, and having under its charge the Fisheries of Scotland, it might be entrusted with the power of making such regulations, with your sanction, or that of the Lord Advocate, as would be capable of being enforced by penalties of a limited amount at the instance of any of its officers before the sheriff. Such a power was conferred upon its predecessors by the Act of 1860, 23 and 24 Vict. cap. 92, sect. 5, and the Act passed in 1867, 30 and 31 Vict. cap. 52, sect. 2, with respect to the Herring Fisheries, and the Board believes

that it would fairly meet all the requirements of the situation, if this latter clause were re-enacted in such terms as would make it applicable to all the fisheries on the coasts of Scotland. In any legislation as to trawling two courses are open. The Statute should either prohibit trawling on any part of the coast within the three miles, except to vessels holding the licence of this Board, authorising them to fish within certain limits on certain conditions; or, the sea should remain as at present, free to all, except such firths and portions of the coast as may be barred to trawlers by Byelaw, to be enacted by the Board with the sanction of the Secretary of State. Of these two proposals, we prefer the latter. We are against making the sea a *mare clausum*. A public licence to exercise an honest calling is opposed to the spirit of our institutions. The true principle is freedom, qualified by such regulations as in the common interest may be found to be just and necessary.

Clause in former Acts should be re-enacted to embrace all Sea Fisheries. Principle of Legislation as regards Trawling.

Previous to the Sea Fisheries Act of 1883 coming into operation, numerous complaints were made by drift net and line fishermen against steam trawlers for damage done to their nets and lines, and the Board instituted a prosecution under the Sea Fisheries Act of 1868 against a steam trawler for contravention of the 15th article of the convention scheduled to that Act, for trawling within three miles of boats fishing with drift nets, and a conviction was obtained against the party. Although the Board was successful in this prosecution, it was of opinion that, owing to the difficulties which arose in the case, it was not expedient to continue such prosecutions until the Act of 1883 was in operation, more especially as it appeared that the 19th article of the convention scheduled to that Act clearly regulated the matter as between trawlers and drift net and line fishermen.

Prosecution under Sea Fisheries Act, 1868, against a Steam Trawler.

Conviction obtained. Difficulties in the case. Act regulates proceedings of Trawlers and Drift-net Fishermen.

The superintendence at sea during the past year was, as usual, carried on by H.M.S. 'Jackal,' under the command of Lieut. J. R. Prickett (with her tender 'Daisy' cutter), and the cruiser 'Vigilant,' under the command of Mr Alexander M'Donald, both these vessels being permanently attached to the Board; and also by the vessels temporarily detached by the Lords of the Admiralty for the great summer herring fishery on the East Coast. The 'Jackal,' with her tender, is usually stationed at Rothesay, and is mainly used for service on the West Coast. The 'Vigilant' is stationed at Granton, and superintends the fisheries on the East Coast, and she is also available for service during the early herring fishing in the Hebrides. As stated, however, in the Board's last Report, in order that the duties of the Board may be efficiently performed, it is necessary that the 'Jackal' be replaced by a seaworthy boat adapted for the work of a fishery cruiser, and that the 'Vigilant,' a sailing vessel of considerable age, be superseded by an efficient steamer, and that each vessel be provided with a suitable tender. This subject was informally brought under the notice of the Admiralty, at an interview with which two of our number were recently favoured by Admiral Sir C. Key, in London, and we have again respectfully, but urgently, to represent that the arrangement proposed should be made without delay.

Superintendence at Sea of Fisheries. To whom entrusted. 'Jackal' stationed at Rothesay. 'Vigilant' stationed at Granton. 'Jackal' should be replaced by a seaworthy vessel. 'Vigilant' cruiser should be superseded by a steamer. Both should have tenders.

The services of the different vessels in 1884 were as follow:—

D

Services of
'Jackal.'
At Ballantrae;

In Hebrides;

On East Coast.

Her return to
West Coast.

Prosecutions
for Contraven-
tion of Sea
Fisheries Acts.
Beneficial
effect thereof.

Commander's
services
appreciated.
'Daisy's'
services.

Interrupted,
owing to
repairs.

Complaint
against Sunday
fishing.

Application to
Admiralty for
protecting
vessel.

H.M. Cutter
'Neptune'
appointed.

Practice
stopped.

Fishing in
Loch Hourn.

Disturbances
apprehended
between Seine
and Drift-net
Fishermen.

Application for
Protection.
'Daisy' sent.

Disturbances
prevented.

Services of
'Vigilant.'
In Firths of
Forth, Tay,
and Beaully.

H.M.S. 'Jackal' commenced her superintendence in the beginning of the year at Ballantrae, on the Ayrshire coast, where a large number of boats had collected, and were carrying on different modes of fishing, with drift, seine, trammel, and cod-gill nets. Lieut. Prickett's services in preventing disputes among the fishermen and preserving order during the fishing were very successful. In the month of May the 'Jackal' proceeded to the Hebrides, and continued superintendence there during the progress of the fishing, after which she was ordered to the East Coast for superintendence of the great summer herring fishery, where she remained till the close of the season, taking charge of the coast of Caithness—her headquarters being at Wick. She then returned to her permanent station on the West Coast, and resumed her superintendence there. In the exercise of this duty Lieut. Prickett instituted prosecutions against several fishing boats for not having their certificates of registry on board, or their boats and sails lettered and numbered as required by the Sea Fisheries Acts and relative orders in Council, and these proceedings had a beneficial effect in deterring other fishermen from contravening the Acts. In the discharge of the duties of superintendent Lieut. Prickett displayed great zeal and energy, and his services were highly appreciated. The tender 'Daisy' took up the superintendence on the west coast in the absence of the 'Jackal' upon the east coast. Owing, however, to her being laid up for repairs during a considerable portion of the time, she was unable to inquire into a complaint made to the Board, that a number of fishermen from Campbeltown were prosecuting the fishing on Sundays in Kilbrannan Sound, in violation of the 11th section of the Act 55 Geo. III. cap. 94. Application was accordingly made to the Lords of the Admiralty for a protecting vessel in the absence of the 'Daisy,' and their Lordships were pleased to appoint H.M. cutter 'Neptune,' under the command of Mr Francis Cleave, to take her place. By her presence in Kilbrannan Sound, and the activity displayed by Mr Cleave, a complete stop was put to the practice complained of. A considerable herring fishing being expected in Loch Hourn, and disturbances similar to those of last year between seine and drift net fishermen being apprehended, an application was made to the Board by fishermen in Lochfyne and elsewhere, who intended prosecuting this fishing with seine-nets, for protection against the native drift net fishermen. The 'Daisy,' under command of Mr Boughton, was ordered, after completion of her repairs, to proceed there and preserve order. Mr Boughton was enabled, in conjunction with Mr Rosie, the Board's officer of the district, by explaining the law to the fishermen, and by constant vigilance both by day and by night, to prevent any outbreak or lawlessness among the fishermen, which at one time, owing to the determined resistance of the drift net fishermen against the seiners, appeared imminent. Further, the firmness on his part, with the assistance of the fishery officer, obtained for both sets of fishermen equal rights of fishing.

The 'Vigilant' cruiser was employed in the early part of the year in the superintendence of the fisheries in the Firths of Forth, Tay,

and Beaully. She was afterwards removed in the month of May to the Hebrides, for the superintendence of the herring fishery, and continued there until her services were required for the east coast summer herring fishery, where she took up superintendence from Aberdeen to Troup Head in Banffshire, a coast extending to 50 miles, and where upwards of 2000 boats were engaged in the herring fishery, besides many trawlers and line fishermen. She afterwards returned to the Firth of Forth, and resumed superintendence there, visiting occasionally the Tay, and the Beaully, and Cromarty Firths, where the sprat fishery was being prosecuted. Her services during the year in rendering assistance to fishing boats in distress, settling disputes among the fishermen, and between the steam trawlers and drift and line fishermen, and instituting prosecutions for contravention of the Acts, were very valuable, and the active and energetic manner in which Mr M'Donald, her Commander, carried out those duties was highly satisfactory.

On East Coast, from Aberdeen to Troup Head.

'Vigilant's' return to Firth of Forth.

Her valuable services.

Commander's activity and energy.

The other vessels which were placed by the Lords of the Admiralty at the disposal of the Board, for the superintendence of the summer herring fishery, were H.M. gunboat 'Firm,' Lieutenant-Commander George Izat; H.M. cutter 'Eagle,' Mr Henry Miller in command; and H.M. cutter 'Squirrel,' Mr J. F. Tremayne in command, tenders from the Leith guardship 'Lord Warden.' The two former vessels were stationed in the Shetland and Orkney Islands, and the latter on the east coast from Red Head in Forfarshire to Aberdeen. There was also stationed on the Northumberland coast, for fishery superintendence, H.M. gunboat 'Ariel,' in command of Lieutenant C. R. Wood, and afterwards Lieutenant Henry M. C. Festing. The Board considers it due to the commanders of these vessels to state its obligations for the efficient manner in which they performed the duties assigned to them, and also to the Lords of the Admiralty for the assistance thus granted for the protection of the fishery upon the coast.

Temporary vessels.

H.M. gunboat 'Firm,'
H.M. cutter 'Eagle,'
H.M. cutter 'Squirrel.'

H.M. gunboat 'Ariel.'

Their efficient Services.

Obligations to Admiralty for these vessels.

In addition to the duties narrated above as performed by H.M.S. 'Jackal' and the 'Vigilant' cruiser, it may be stated that these vessels were also engaged in carrying on scientific investigations into the habits of food-fishes, under the superintendence of the Board, of which mention is made in another part of this Report.

'Jackal' and 'Vigilant' also employed in Scientific Investigations.

THE TITLES TO FISHERMEN'S HOUSES.

In most of the fishing towns and villages along the north-east coast and islands fishermen are mere squatters, who have built or bought houses to which they have no feudal title. Representations having been made to us on this subject by the Sheriff of Aberdeen, Kincardine, and Banff, a member of the Board (whose attention had been drawn to it from cases which had come before him judicially), he, at our request, made certain inquiries in Banffshire, with the following result:—

Fishermen's Houses commonly held without Titles.

In the town of Buckie there is a population of 4176, and 940 houses. Of these about 350 belong to fishermen, and of these

Extent of the Practice. Buckie.

fully less than one half are held without a feu charter or lease of any kind. The yearly rental of these houses held without title is estimated at £800 to £900.

Port Gordon. In the village of Port Gordon there are 104 houses, mostly owned by fishermen, having a total yearly rental of £812, and of these there is not one feu charter, and only two who hold a lease of any kind. The rental of houses without title is about £750.

Portessie. In the village of Portessie, with a population of 980, there are 178 houses, mostly belonging to fishermen, or those connected with the fishing industry, with a yearly rental of £872, and not a single house is held by a charter or lease of any kind.

Findochty. In the village of Findochty, with a population of 936, there are 180 houses, mostly belonging to fishermen, with a yearly rental of £786, 10s., and only three have charters or leases of any kind. The rental of houses without title is £740.

Port Knockie. In the village of Port Knockie, with a population of 1100, there are 213 houses, mostly belonging to fishermen, with a yearly rental of £1072, and only eight have charters or leases of any kind. The rental of houses without title is £950.

Sandend. In the village of Sandend, with a population of 256, there are 52 houses belonging to fishermen, with a yearly rental of £142, and there is not one charter or lease.

Whitehills. In the village of Whitehills, with a population of 920, there are 200 houses, mostly occupied by fishermen, with a yearly rental of £927, 10s., and only about 50 have a title of any kind. The rental of the houses without title is estimated at £600.

Gardenstown. In the village of Gardenstown, with a population of 271, there are 170 houses, mostly owned by fishermen, or those connected with that calling, with a yearly rental of £1132, 15s., and about 60 hold a title. It is estimated that the yearly rental of the houses held without title is £450.

Crovie. In the village of Crovie, with a population of 320, there are 66 houses belonging to fishermen, with a yearly rental of £248, and no one holds a title of any kind.

The result is that on the Banffshire coast alone, property is held without any title having a yearly rental of £5500.

Generality of Practice in Islands. But the same system prevails in Orkney and Shetland, the Western Islands, and in many other districts along the coast.

The effect is to hamper the fishing interest to a most material extent in many ways.

Value of Property so held. Taking the value of the property in Banffshire at only ten years' purchase, £55,000 of the fishermen's money is in that district locked up in property, which cannot under any circumstances be to any extent made the subject of security or credit, while with a feudal title the fishermen could readily borrow £35,000 on the security of the subjects.

Evil results of System. As matters stand, if a fisherman so placed, loses his boat or nets, he cannot use his house to obtain an advance from a bank, or a permanent loan to enable him to supply his loss, and being deprived of his working plant, he must often take employment as a hired man.

Again, the fisherman has not encouragement or even safety to improve or extend his house. In consequence, he is often not only

compelled to keep his family in a wretched house, but he has no proper protection for his nets, lines, &c., and they prematurely rot and decay, to his serious loss.

The disability of a fisherman to borrow on his house also has the effect of driving him to dealing with unscrupulous traders, &c., by whom he is overcharged or otherwise cheated and involved in debt, which he soon loses all power of reducing.

The increased size of fishing boats has necessitated the erection of some kind of harbour at almost each fishing town and village, instead of the creeks hitherto used. The want of titles to their properties is a great barrier to the fishermen helping themselves as to harbour accommodation. If a Harbour Company is formed, fishermen are unable to raise money to take shares, or to raise the sum required as a local contribution, to enable them to obtain a harbour grant.

The present anomalous state of matters has existed from a very remote date, and appears to have grown out of a feeling between the fisherman and the superior of the villages, handed down from generation to generation, of trust on the one side, and benevolence on the other. In some villages the custom was to pay a cod fish yearly in name of rent, which must have been intended as a mere recognition of the superior's right. When subsequently, in one of these villages, the people were charged a sum per pole, the claim was resisted, and as the superior's demands rose they evoked still more opposition, till actions of removing were raised, to which, of course, there was practically no defence. Instead, however, of proceeding with the judgment given in his favour, the superior agreed to grant, and the fishermen to accept, 99 years' leases, at the rate of 4d. per foot of frontage, which is something like 2s. 6d. per pole, or £20 per acre.

Transactions with respect to property without title usually take the form of a letter, written and signed by the seller, specifying the sum to be paid, and the terms of payment. Following on this document, the buyer gets a receipt for the money, and on production of these documents the factor of the proprietor enters the buyer's name in his rent book. This, however, is always without prejudice. It does not amount to a waiver of the proprietor's right over the subject. It does not foreclose him from bringing an action of removing at any time. It does not mean that in all cases when a fisherman dies his eldest son shall be recognised as heir. Very often his right is conceded, but instances to the contrary have occurred. In the village of Rathven a man who had built a house died. His eldest son applied to the proprietor to have his name entered in the rental book as his successor, but his claim was refused, on the ground that the proprietor wished to 'resume possession'—i.e., to appropriate without compensation the fruit of the poor man's industry.

It must not, however, be thought that the proprietors are responsible for the system which now prevails. From time to time fishermen have been allowed to build, till considerable villages have come to be formed—an example on the superior's part of the old feudal feeling in its best light—while on their part the fishermen were indifferent to things being put in legal form, having

Its origin.

How Purchases are made.

Relation of Buyer to a Superior.

Proprietors ready to grant Titles.

perfect confidence in the 'laird,' and disliking much both lawyers and law expenses. It is understood that the proprietors along the coast are ready to grant feu rights, generally on fair terms; and if in former times there ever did exist political reasons for not granting feu charters, as thereby the fishermen became entitled to the franchise, all such considerations have ceased to be of the slightest moment, because every one has now the vote.

Disadvantage
to Superior of
present
system.

It is also for the interest of the owners of the land, no less than for the advantage of the owner of the building, that their respective rights should be clearly defined in some kind of legal title. In the Valuation Roll, a fisherman who has bought his house without title, is entered as proprietor and occupant, and the value is stated, not at the rent of the ground, but the sum at which the property would let one year with another, as in the case of any other description of heritable property. It is obvious that these entries are not strictly in accordance with fact. There is no proprietor but the superior, and under several decisions of the Court of Appeal in valuation causes, property erected without any title at all, or under a lease for less than 21 years, cannot appear in the Valuation Roll; it is, in fact, lost for assessing purposes. It follows that in the Valuation Roll the rent of the ground only could legally be inserted against the superior's name, and it may be seriously questioned whether in these fishing villages, except in cases in which titles have been granted, there is any taxable subject at all besides the ground, and whether the superior with a number of dependents sitting without title, is not liable personally in payment of all their taxes.

Proper
Remedy.

It may be argued that the parties themselves should be left to find their own remedy under the existing forms of conveyancing, and that no special legislation is needed. We are of a different opinion. Leasehold tenure is not popular in Scotland. When a man buys a house, he wants it to be his, out and out, and for ever. In regard, again, to the ordinary charter and sasine, much as the system of conveyancing has been simplified within the last few years, it is still very expensive. And above all, in any plan which may be adopted, provision would require to be made for the intervention of some judicial authority, to fix and determine, in the event of the parties themselves being unable to agree, what is the proper rent or feu duty to which, in all the circumstances, the superior is fairly entitled. This, we think, should be in the form of a uniform annual payment, and no other casualty should be allowed. The Sheriff is the natural officer to settle this matter; and under his direction the Sheriff Clerk might open a register, to be called the Register of Small Holdings, which could be so arranged as to reduce the cost of conveyancing to a nominal sum, and yet confer a perfectly efficient marketable title. The following are the leading features of the scheme now respectfully submitted to your consideration:—

Suggested new
Register.

Leading
Features of
Scheme.

(1) The register would be made up in the form of the Valuation Roll, but with a fuller description of the property, by its boundaries, or by reference to the Ordnance Survey Map. No conditions, servitudes, or qualifications of the title could be admitted. When the property could be only held subject to these, the Register would

be inapplicable, and the parties would have to betake themselves to the existing forms.

(2) An owner who had arranged with his superior as to the terms on which the title was to be taken, or who was willing to arrange, should be entitled to make application by petition to the Sheriff Court to have his property entered in the Register.

(3) Failing adjustment, the Sheriff would fix the rent or feu duty, and decide any other question as to boundary, &c.

(4) As soon as the entry was complete, the owner would receive a printed extract, specifying the subject, the superior, the feu duty, and the number of the folium of the Register, each property having a folium to itself.

(5) When he wanted to sell, he would write across the extract, 'I transfer to A. B.,' or to borrow 'I transfer to C. D., in security 'of,' and this would be a sufficient warrant to have the proper entry made in the Register, divesting the one and vesting the other. When the loan was repaid, the Registrar would enter 'Paid off.' When the owner died, the Sheriff, instead of serving the heir, would direct the Sheriff Clerk to make the proper entry. No trust could be admitted nor family settlements. When it was sought to bring the property under a will, marriage contract, or trust deed, the transfer would be made to the trustee without any qualification *ex facie* of the Register, but a declaration of trust executed by the transferee would be deposited with the Sheriff Clerk, and a caveat entered, which would bar any dealings with the property till the trusts were fulfilled. The title would thus be indefeasible, cost next to nothing, and confer a great benefit on the fishing population.

The Board has felt the inconvenience of so much property being held without title, as the fishermen are practically unable to raise the requisite local contributions for obtaining a Fishery Board Grant to enable them to build a harbour.

Difficulties caused by existing system in raising Money for Harbours.

In giving evidence before the recent Harbour Commission, Mr R. W. Duff, M.P., proposed to extend the operation of the Act 45 and 46 Vict. cap. 62, to all seaside towns and villages, by a provision to the following effect:—

'With respect to seaside towns and villages in Scotland, which are not royal or parliamentary burghs, or populous places fixed under the General Police Act, or any local Act, any ten owners of lands and heritages within said town or village, held under feu charter or building lease enduring for not less than 99 years, may present a requisition to the Fishery Board for Scotland, requiring that Board to consider the propriety of forming such town or village, and any part of the district adjoining, described in such requisition into a special harbour supply district, and to define a rating authority for the administration thereof, and the number and qualification of the members thereof, the mode of the election of such members, and the duration of their period of office. Upon receipt of such requisition, the Board shall as soon as possible give intimation thereof, and of a diet to be fixed by them for considering such requisition, at which all parties interested may appear and be heard, by advertisement published at least three times in a newspaper published within the county, and by handbills published and circulated in said town or village and adjoining

Suggestion of Harbour Districts.

' district; and after hearing all parties interested, the said Fishery Board may either approve or disapprove of the craving of such requisition; and if they disapprove thereof, they may either find that no special harbour supply district should be formed; and if they approve thereof, they may find that a special harbour supply district should be formed, and define the limits thereof; and in defining such they may enlarge or restrict the special district as specified in the said requisition, and they shall also define a rating authority for such district, and fix the number and qualification of the members thereof, the mode of their election, and the period during which the members are to hold office, and the decision of the Board shall be final and binding on all parties concerned.

' Every rating authority of a special harbour supply district, formed in terms of the foregoing section, shall be a rating authority for the whole purposes, and with the whole powers specified in the Act 45 & 46 Vict. cap. 62.'

If this proposal were carried out, it would be practically inoperative in the villages where the fishermen have no titles, except in the cases where ten feuars or leaseholders exist, and it raises a strange anomaly. Suppose, for instance, that Port Knockie was formed into a special harbour supply district, only a mere fraction of the property included in the district, and made a security for the loan, would legally be the property of those resident in the district.

Plan impracticable for want of Titles.

TELEGRAPHIC EXTENSION.

Telegraphic Communication to Castle Bay, and to Orkney and Shetland.

Agreements entered into.

Appreciation of Fishermen and others of the benefits conferred.

Illustration thereof from Orkney.

Other applications for Telegraph Wires.

The arrangements for carrying out Telegraphic Extension to the following fishery stations mentioned in the Board's last Annual Report, viz., Castle Bay, Island of Barra; St Mary's, Barra; and St Margaret's Hope, Orkney; and Reawick and Vaila Sound (Walls), Shetland, were completed in the course of last summer and the necessary formal agreements entered into between the Board, the Localities, and Her Majesty's Postmaster-General; and the Board is now glad to say that telegraphic communication has been opened with these remote places.

These telegraphic extensions have been much appreciated by the fishermen and other persons engaged in the fishing industry, and although not much experience has yet been had of benefits derived from their operation, there is every reason to believe that the favourable anticipations which were formed regarding them will be realised. In illustration of this, it is worthy of mention that in the Orkney Islands during last season, when there was little or no fishing going on at the South Isles, the fishermen there got information by telegram that herrings had appeared in large numbers off the North Isles, and, proceeding there, landed in one week £1800 worth of fish, which, without the information conveyed by telegram, would not have been got.

The Board has received applications to lay telegraph wires to other remote fishery districts, but as it is uncertain how much of the funds placed at its disposal for telegraphic extensions will be

required to pay to the Postmaster-General, under the guarantees it has given him, as to the above-mentioned works which have been completed, it has been obliged to delay for the present the consideration of these applications.

Consideration thereof delayed.

HARBOURS.

In the Board's last Report there was given a list of places from which it had received applications for assistance to aid in the construction or improvement of Fishery Harbours, and since that time applications have also been received from the following places, viz:—Avoch, Rosshire; Inverallochy, Aberdeenshire; Cowie, Kincardineshire; Tyree, Island of Mull; Keiss, Caithnesshire; and Golspie, Sutherlandshire.

Applications for Assistance to Fishery Harbours.

In Appendix E will be found a Report by the Engineers upon the state of the harbour works in progress under the Board, together with details of Surveys and Reports which it recently authorised.

Engineers' Report on Harbour Works in progress.

The harbour at Ness, Island of Lewis, was commenced by the former Board in the year 1836, when a small quay was erected and projecting rocks on the beach were smoothed down; and at a later period some additions were made, consisting mainly of a new approach; a slip with gearing for hauling up the boats; and a platform on which the boats could be placed after being drawn out of the surf. But the works as executed afforded no sheltered accommodation, and every time the boats went to sea they had to be launched and hauled up on the beach on their return. In order to promote the development of the important fisheries in this district, the Board was glad to be able to arrange, with the assistance of Lady Matheson, for the construction of a new harbour. The works, which have been in progress during the past two years are nearly completed, as will be seen from the Engineers' Report; and the design has been so framed as to be capable of future extension. Already the harbour is taken advantage of by about thirty boats, which find sheltered accommodation in it; and, as evidence of the practical benefit to the district, which is remote from the regular markets, two smacks have already begun to ply between the harbour and Stornoway, whence the fish can be sent south, either directly by steamer to Glasgow, or by steamer to Strone Ferry, and thence by railway to the south. It is to be regretted that the area of the harbour is not larger, but it could not have been increased unless at a greater expenditure than the funds at disposal allowed. There is every probability that the advantages of the sheltered accommodation afforded by the new harbour will lead to more and larger boats being employed by the Ness fishermen, and at no distant period it may be found necessary for the proper development of the fishing industry to increase the harbour accommodation so as to shelter in safety a larger number of craft.

Ness Harbour, Island of Lewis.

Findochty Harbour is one of the works originated by the former Fishery Board, which was taken over and completed by the present Board. As will be seen from the Engineers' Report the work was satisfactorily finished in November last. There are in all 128 boats

Findochty Harbour.

belonging to Findochty, 84 of them being 30 feet keel and upwards, and there are 235 resident fishermen and boys. The new harbour will supply for the first time suitable sheltered accommodation, the area being nearly $4\frac{1}{2}$ acres, as well as ample quay room for the discharge of fish.

Crovie Landing
Slip.

The fishing creek of Crovie, near Gardenstown, in Banffshire, has about 60 boats belonging to it, but it had no harbour accommodation of any kind, and as the required contribution which the district could pay was very restricted in amount, all that it was possible to do for the fishermen was to provide a small landing slip, at which boats could land in good weather and be hauled up. This small work was accordingly undertaken by the Board. It is now in progress, and it is hoped will shortly be completed.

St Monance
Harbour.

The harbour of St Monance is a good instance of the progressive development of the fishing industry. Twenty years ago the resident fishermen, unaided by any government grant or assistance from the proprietors of the district, erected a harbour from a design made by the engineers of the Board at a cost of about £7000. This harbour was found, after fourteen years of progress, to be too small for the increasing trade and the gradually increasing size and draft of the fishing boats, and an extension of the harbour accommodation was accordingly secured at a further cost of upwards of £8000, making, with the former expenditure a total sum of not less than £15,000. The extension was completed in 1879. Though the fishermen (like those at Port-Seton on the opposite side of the Firth, who have also built an excellent harbour at their own cost), had thus, with praiseworthy self-denial and energy, built for themselves an excellent harbour, it was found that the ever-increasing size of the boats rendered it necessary that the outer entrance channel should be widened, deepened, and sheltered. But previous efforts had so crippled the financial resources of the fishermen, that they were unable without assistance to carry out this most desirable improvement. Application was accordingly made to the Board for a grant in aid as mentioned in last year's Report. After due consideration, the Board had very great satisfaction in extending its help to the fishermen, who had shown so much spirit and independence. The work, which was accordingly undertaken, has now been completed. In addition to the rock excavations, and works in the entrance channel, improvements on the pier-head and landing slip were made, the whole being executed within the sum allowed for the work.

Stonehaven
Harbour.

Application having been made to the Board by the Commissioners and Trustees of the Harbour at Stonehaven for a survey, design, and report on the extended works proposed there, for which they offered to pay one-half of the cost, the Board, being deeply impressed with the necessity which exists for improved harbour accommodation at Stonehaven, which is readily accessible from rich fishing grounds, instructed Messrs Stevenson, its engineers, to do what was wished. The engineers have furnished a report and plan of what they would recommend, which have been sent to the Commissioners and Trustees for their consideration.

Broadford
Harbour, Skye.

With reference to the application on behalf of the fishermen at Broadford for an improvement and extension of the harbour there

the Board, upon a report by its district officer pointing out the importance of such a work, agreed to have a preliminary survey and report made by its engineers at the joint expense of the Board and the locality. A survey was accordingly ordered, and a report supplied by the engineers containing their recommendations, which was sent to the applicants for their consideration, but in consequence of want of funds no further steps have as yet been taken in the matter.

It is a source of much regret to the Board, that owing to the limited funds placed at its disposal to aid in the improvement and construction of fishery harbours, it has not found itself in a position to comply with any of the other applications for assistance which have been made, being fully satisfied that the carrying out of several of the works proposed would materially tend towards the improvement and development of the fisheries. The Board begs, however, to express the hope that when Parliament comes to consider the Report of the Committee of the House of Commons which was appointed to inquire into the harbour accommodation on the coasts of the United Kingdom, the claims of the fishery interests of the kingdom to have better harbours provided will meet with their favourable consideration.

Inability of Board to assist other Piers and Harbours.

Hopes Parliament will favourably consider Fishery Interests.

It is an important question how such harbours as these, which have to a large extent been built with public money, are to be managed and maintained. It would be very desirable if facilities could be given for the formation, amongst the fishermen themselves, of a Harbour Authority, which would be empowered to take charge of the works, levy dues upon boats taking advantage of the harbour, and execute necessary repairs. The Board has already made a communication to you on this subject which you have been so good as submit to the Board of Trade.

Facilities desirable for formation of Harbour Authority.

In Appendix E will be found an account of the sums received and paid by the Board last year for building or repairing piers and harbours, together with a statement of the sums received, ex herring brand fees, for harbours and telegraphic extension to remote fishery districts.

Sums received and paid for Piers and Harbours.

SALMON FISHERIES.

Since the beginning of 1883, Mr Young, Inspector of Salmon Fisheries, has, by the direction of the Board, inspected the Salmon Rivers on the East Coast of Scotland, from the Forth to the Kyle of Sutherland, both inclusive; the Salmon Rivers falling into the Scotch shore of the Solway Firth, and those of Ayrshire; and the rivers and lochs that would be opened up by making the Falls of Tummel passable for salmon. On all of these he has given in Reports to the Board, which have been printed along with its Reports addressed to you. Last year, Mr Young inspected the Salmon Rivers in the counties of Caithness, Sutherland, Ross and Cromarty, Inverness, Argyll, and Dumbarton, and has presented a Report thereupon to the Board, which forms Appendix G, pp. 93-200. The Board approved generally of this Report after having given it careful consideration. Mr Young has drawn up a map, which is prefixed to this Report, in which, for the first time, the limits of the 105 Fishery

Mr Young's Inspections and Reports thereon to the Board since the beginning of 1883.

Districts into which Scotland has been divided under the Acts of 1862 and 1868 are distinctly laid down, and those Districts which have District Boards are distinguished from those which have none. In this map, also, the principal obstructions on the salmon rivers in Scotland, in the shape of waterfalls, are clearly marked—those which are absolutely impassable being indicated by blue crosses and those which are only partial obstructions being marked by red crosses. At least 600 miles of rivers and lochs are at present barred against the ascent of salmon by these obstructions. The Falls of Tummel alone, for example, shut out from 30 to 40 miles of rivers and 20,000 acres of lochs; the Falls of Mounessie on the Spean, 40 miles of river and lochs; the falls on the Conon and its tributary the Orrin, from 35 to 40 miles of water; and the Falls of the Kirkaig, in Sutherlandshire, 7 miles of river and 1800 acres of lochs. It is hoped that this map will show, almost at a glance, the position of these and many other minor obstructions; and will also prove useful and convenient in explaining, far more clearly than any written description could possibly do, the situation and size of the Fishery Districts in Scotland, and the extent to which the system of District Boards has been carried out.

Inspections
yet to be
made.

The valuable Salmon Fishings in the Inner and Outer Hebrides, and the important sea-trout fishings in the Orkney and Shetland Islands, the latter of which were brought under the operation of the Scottish Salmon Fishery Acts of 1862 and 1868, by byelaws approved and signed by the Secretary of State in 1882 and 1883, have not yet been inspected. But Mr Young has been directed by the Board to inspect the fisheries in the Inner and Outer Hebrides during the summer of this year.

Salmon
Disease.

In the course of his inspection of the Salmon Rivers on the north coast of Scotland, from Duncansby Head to Cape Wrath, and on the west coast, from Cape Wrath to the Mull of Cantire, Mr Young neither met with nor heard of any case of the salmon disease. But in the Helmsdale, one of the best salmon rivers in Sutherlandshire, which falls into the north side of the Moray Firth, two cases occurred, and were brought under the notice of the Board in the beginning of last winter. A Report was made on the subject to the Duke of Sutherland by the Professor of Anatomy in the University of Edinburgh, to the effect that both the fish submitted to him for examination were affected by the salmon fungus or *Saprolegnia ferax*. The Helmsdale flows out of and through a series of great lochs, and is perfectly pure and unpolluted; and, though a very productive river, it is by no means overstocked with fish; so that neither pollutions nor overcrowding, which are alleged by many to be fruitful sources of the disease, can have had anything to do with the cases in question.

Exceptional
position of the
River Eden
which falls into
St Andrews
Bay.

A reference was made to the Board during the past year, pointing out the anomalous and exceptional position of the Eden, a very good sea-trout and fair salmon river, which falls into the Bay of St Andrews, and which, though nominally within the limits of the Tay District, is not under the jurisdiction of the Tay District Board, owing to an error in the wording of the Byelaw constituting and defining the Tay District. The consequence is that the Eden is very much poached, there being no official body to protect it,

and there being doubts as to the beginning and termination of the annual close time applicable to it. The Board, however, has no power to interfere, as there is no provision in the existing Acts empowering the Secretary of State to alter or amend a Byelaw constituting a District which has once been sanctioned by the Home Office.

Complaints were made to the Board with regard to the illegal working of the Doachs at Tongland, on the Kirkcudbrightshire Dee. The Doachs at Tongland. These Doachs are fully described by the Inspector in his Report of 1884 on the salmon rivers falling into the Scotch shore of the Solway Firth. There is a regularly constituted District Board on the Dee, whose duty is to prevent all illegal fishing within their district, and to see that the provisions of the Acts of 1862 and 1868 and relative Byelaws are strictly enforced; and, as the Act of 1882 constituting this Board, and giving it the general superintendence of the Salmon Fisheries in Scotland, at the same time declares that this shall be 'without prejudice to or interference with the powers of District Boards,' the Board did not consider itself either bound or entitled to interfere in the matter.

In the course of last year, complaints were likewise made to the Board by proprietors and lessees of salmon fishings of the frequency of illegal netting of salmon and sea-trout by yachtsmen, while cruising in summer and autumn along the coasts of the western mainland of Scotland and among the Hebrides. This is a grievance of long standing; as so far back as February 1874, a circular was drawn up, with the sanction of the Home Office, by the Commissioners of Scotch Salmon Fisheries, pointing out the law on the subject, and was sent to the secretaries of all the yacht clubs in the United Kingdom. This, however, having proved unavailing to put a stop to the practice, the Board considered it right to send another circular on the subject to the secretaries of the various yacht clubs. This circular was also inserted in a number of the leading newspapers. A copy of it will be found in Appendix G. Illegal Fishing by Yachtsmen.

In the end of last summer, the Tay District Board addressed a memorial to this Board on the subject of the pollution of the salmon rivers of Scotland and its deleterious effects on the fishings. The polluted river basins of Scotland, as may be seen by a reference to the map of the River Pollution Commissioners published in 1874, extend over many hundreds of square miles in Aberdeen, Forfar, Fife, Lanark, Dumbarton, Stirling, Ayr, the Lothians, Roxburgh, Pollution of Rivers. and Berwick; and the clauses in the existing Salmon Fishery Acts of 1862 and 1868 have proved utterly inadequate to cure, or even to check, the yearly increasing pollution of our rivers. Many formerly productive salmon rivers have been reduced to absolute sterility from the variety and virulence of the pollutions poured into them. The Clyde above Dumbarton; the Irvine and Ayr; the Carron, Devon, Almond, Avon, and Leven, in the Forth District; the Dighty, Almond, and Ericht, in the Tay District, and several other rivers that might be mentioned, are all now salmonless, or nearly so, owing to pollutions from mills and manufactories. The subject has been discussed at considerable length by the Inspector in his Report of 1883 to the Board on the Salmon Rivers of Scotland from the Forth to the Kyle of Sutherland, both

inclusive (pp. 41–43). He there recommends that the following clause should be introduced in any future Salmon Fisheries Act, for the purpose of preventing the pollution of the salmon rivers of Scotland:—‘Section 13 of the recited Act 25 and 26 Vict. cap. 197, and section 16 of the recited Act 31 and 32 Vict. cap. 123, are hereby repealed; and it is hereby enacted that, from and after the passing of this Act, each District Board, within its own district, shall have and possess the same powers of prosecution for the prevention and abatement of pollutions in rivers and waters, as are at present competent to individual riparian owners in such district.’

Alteration of
Rod Fishing
season on
Annan and
Nith.

The District Board of the River Annan petitioned the Secretary of State last summer, under the 9th section of the ‘Salmon Fisheries (Scotland) Act, 1868,’ to alter the annual close time applicable to that river, so far as the rod fishing is concerned, and to make the rod fishing extend, after the nets are off on the 10th September, to the 15th November, instead of to the 31st October. This petition and relative papers were referred by you to the Board for their remarks thereupon; and the result is that the extension of time has been granted by Order under your hand, so that the rod fishing season on the Annan now extends from 24th February to 15th November.

A similar petition was subsequently presented to the Secretary of State by the District Board of the River Nith, which was likewise referred by you to this Board for its remarks thereupon. The result is that the prayer of the petition has been granted, and that the rod fishing season on the Nith is now the same as that on the Annan—the river immediately contiguous to it on the east—extending from 24th February to 15th November.

Marking out
the low-water
channel of the
Solway Firth.

The subject of marking out distinctly and permanently, by buoys or otherwise, the centre of the low-water channel of the Solway Firth between Sark Foot and a line drawn from Carsethorn of Arbigland to the Hotel of Skinberness, was brought, during last year, under the notice of the Board; but there are considerable practical difficulties in the way of carrying it out. If, however, it could be accomplished, it would put a stop to many disputes, and would greatly facilitate the putting down the killing of salmon by unqualified persons in the low-water channel of the Solway Firth.

Proposals for a
new Salmon
Fishery Bill.

In the close of last year, the Board had the honour of complying with your request to submit proposals for a new Salmon Fishery Bill for Scotland.

Decrease in
the take of
Salmon in
1884, as com-
pared with
1883.

The year 1883 was an exceptionally good salmon year in Scotland, the best, indeed, taking the number of boxes of salmon sent to Billingsgate Market as the criterion, that has occurred for the last fifty years, with only the two exceptions of 1835 and 1842. In 1883, 35,506 boxes of salmon were sent to Billingsgate from Scotland; but, in 1884, there was a considerable falling off, only 27,219 boxes having been sent. There has, therefore, been a decrease of 8287 boxes, which, at £8 a box, gives a falling off in value of £66,296; and if we allow for a corresponding falling off in the number of boxes sent to other parts of England, and consumed at home in Scotland, the total decrease in value is, probably, about £75,000.

But, although, when compared with so productive a year as 1883,

the year 1884 shows a considerable falling off in the take of salmon, it is by no means a bad year, as the following statement of the number of boxes of Scotch salmon sent to London during the decennial period from 1875 to 1884, both inclusive, will show:—

Years.	Boxes of Salmon sent to London from Scotland.	Years.	Boxes of Salmon.
1875,	20,375	1880,	17,457
1876,	24,655	1881,	23,905
1877,	28,189	1882,	22,968
1878,	26,465	1883,	35,506
1879,	13,929	1884,	27,219

SCIENTIFIC INVESTIGATIONS.

Under the section devoted to Scientific Investigation in the Report for 1883, it was mentioned that it was proposed, amongst other things—(1) to continue the examination of the spawning beds around the coast; (2) to collect material for determining the nature of the food of fishes; (3) to consider the influence of the various modes of fishing in destroying immature fishes; (4) to study life history, rate of growth, nature of the eggs, and method of spawning of the food fishes; (5) to inquire as to the possibility of restocking deserted fishing grounds; and (6) to inquire as to the influence of fungi and other minute organisms in destroying the life of useful fishes. In order to engage in these various inquiries, the Board indicated that a sum of £1000 would be required during 1884-85, and in addition a sum of £1200 for the erection of two small laboratories. It was further pointed out that no satisfactory results could be obtained unless the gunboat H.M.S. 'Jackal' and the sailing cruiser 'Vigilant' were superseded by two efficient steam vessels, each provided with a suitable steam tender. The Board, by way of explaining at length what was wanted for carrying on the above mentioned and other inquiries, sent two of its members with the deputation representing fish-curers and others interested in the sea fisheries which you received in June last. As a result of this and other representations in favour of providing sufficient funds and suitable vessels, to admit of continuous investigations being carried on, it was intimated to the Board early in October that the sum of £1000 would be placed at its disposal, to be applied as indicated in the last Report, during the remaining part of the financial year 1884-85.

While the matter was under consideration during the summer and autumn, the scientific work was in a great part suspended, as the Board had neither funds nor suitable boats or other appliances for carrying it on. During the autumn, however, an attempt was made by utilising the fishery cruiser, H.M.S. 'Jackal,' as long as it could be spared from the work of superintendence, to carry on several of the inquiries above referred to. The 'Jackal' being very unsuitable for the work in hand, and only at the disposal of the Scientific Committee for a few weeks, and the Govern-

Proposed
Investigations.

Work sus-
pended for
want of Funds,
&c.

ment being unable to provide a suitable steam boat, Professor Ewart placed at the disposal of the Board a small steam yacht which he had specially fitted up for dredging and other work.

This rendered possible further experiments as to the best mode of hatching herring ova, the rate of development, &c. of the fry, the relative quantity of flat fish, and the condition and extent of the mussel scalps in the Cromarty and Dornoch Firths.

Professor Ewart requested to Report on the work accomplished by the U.S. Fish Commission.

The Board having recognised that great progress had been made in practical fish culture in America, requested Professor Ewart to proceed to New York, and join Sheriff Guthrie Smith as early as possible in October last, and report as to what had been done in Canada and the United States in the way of increasing the fish supply by artificial means, and as to the appliances provided for studying the life history, habits, &c. of the food fishes. This step was taken by the Board in order that it might benefit by the experience gained in America, and admit of the scientific work being carried on as economically as possible.

Professor Ewart, finding on his arrival in America that Sheriff Guthrie Smith was unable to join him in the inquiry, proceeded to examine first, the fish-hatching stations in Canada, and afterwards the principal hatching stations and laboratories belonging to the United States Fish Commission. A Report, dealing chiefly with the work of the United States Fish Commission, will be found in the Appendix. From this Report it will be seen that, although nothing has yet been done in Canada in order to throw more light on the habits, &c. of the sea fishes, considerable progress has been made in forming a collection of the Canadian food fishes, fishing implements, and fish-hatching appliances, and that several hatching stations have been established in which large numbers of eggs of salmon and white fish are annually hatched at the public expense.

It will be further seen, that in addition to visiting the Central Station of the United States Fish Commission, and the Carp Ponds in Washington, Professor Ewart was able to study carefully the arrangements at the large Marine Station at Woods Holl, where the hatching of sea fish is carried on, and where during the summer and autumn a large staff is engaged studying the development, habits, &c. of fish and other marine forms. Professor Ewart also visited the Bucksport and other stations for hatching salmon and trout, and studied the arrangements for receiving and preserving fish adopted at Gloucester, Boston, and New York, and also the methods for utilising the bye-products of the fisheries, and examined the various kinds of boats and appliances in use amongst the American fishermen, and the splendid vessel 'Albatross,' recently constructed for the scientific work of the Fish Commission. It seems that since the Commission was instituted in 1871, attention has been chiefly directed to increasing the supply of salmon and shad, to the introduction of the German carp; but, in addition, a number of interesting experiments have been made with sea fishes. From one of these experiments it has been inferred, that if young cod-fish are introduced in sufficient numbers into any suitable bay they are likely to remain there for several years, perhaps until maturity is reached. It will be seen from the Report that the

United States Fish Commission consider it the best policy 'to expend a small amount of public money in making fish so abundant by artificial means that they can be got without restriction, and serve as cheap food for the people at large, rather than to expend a much larger amount in trying to prevent people from catching the few that still remain after generations of improvidence.'

In order to be in a position to carry on investigations and hatching operations on the lines which have proved so successful in America, the Board will require to be provided with—(1) a well-equipped laboratory, with suitable hatching tanks, and at least one large sea water pond; (2) a cruiser adapted for carrying on dredging and other operations; (3) two small steam tenders adapted for inshore work; (4) a sufficient annual sum of money to meet the working expenses of hatching and other operations and provide the necessary apparatus. From the information gained in America, the Board feels that, if provided with sufficient funds and with increased powers, it might be able to greatly increase the number of useful food fishes in the firths and bays and other waters around the coast.

Requirements
for scientific
investigations.

In the Board's last Report it was mentioned that a marine station was in process of formation at St Andrews. This station was completed during the autumn, and since then a number of interesting inquiries have been instituted, more especially as to the nature of the eggs and the rate of growth of fishes, and the life-history of the common mussel. Recently an assistant naturalist has been sent to this station, to carry on investigations under the direction of Professor M'Intosh, F.R.S. This station will form a convenient centre from which observations may be made, and experiments carried on, as to the influence of trawling and other modes of fishing in the Firth of Tay and St Andrews Bay.

St Andrews
Station.

As the work of the Scientific Committee increased, it was found that satisfactory results could not be obtained, and continuous observations made, unless the Committee obtained the assistance of an experienced naturalist, who would devote his whole time to the work of inquiry. Early in January Mr Brook, F.L.S., of Huddersfield, who had been for some time studying the life-history and habits of fish, and who had gained considerable experience in organising and carrying on a marine laboratory, consented to place his services at the disposal of the Board. The Board, believing that important results would be gained by a careful study of the west coast fishing grounds, instructed Mr Brook, soon after his arrival, to make a careful investigation of the coast between Rothesay and Ardrishaig, with a view of selecting a site for a temporary laboratory. It being desirable to select a locality which, besides having all the requisites necessary for a marine laboratory, would also be near a large fishing centre, East Loch, Tarbert, was finally fixed upon as offering the most advantages; and a convenient piece of ground opposite the pier at Tarbert, known as the 'White Shore,' was chosen as a site for the temporary hatching station. The proprietor, Colin G. Campbell, Esq. of Stonefield, kindly put what ground was necessary at the disposal of the Board for a term of years at a nominal rent. The work of erecting

A Naturalist
engaged.

Erection of a
temporary
Laboratory
at Tarbert,
Lochfyne.

Description of
Station.

the station was begun almost immediately, and operations are already so far advanced that scientific observations are now in progress. The main building, which is composed of wood, is 40 feet long by 20 feet wide. It is divided into two rooms; a small one at the north-west end of the building is fitted up as a work-room, and the larger one is provided with tanks. A table runs the whole length of the room on each side, furnished with glass aquaria for hatching and other purposes, and along the centre of the room there are five large tanks for fish and other marine forms. Outside the building there are at present two concrete tanks, 15 feet by 5 feet and 3 feet deep, which are intended for large fish while under observation, and there is sufficient room available for six or eight more. These will also be used as rearing ponds for the young fish after they have been hatched out in the glass jars. The water is very pure in this locality; and as there is a plentiful supply of food for the young fish, it is confidently hoped that greater success may attend these experiments than has been the case elsewhere. The water supply for all the tanks is obtained from the sea some distance below low water mark, and is pumped up into a large cistern 10 feet above the ground, which holds a sufficient supply to last three or four days in case of accident to the machinery. In addition to the arrangements already described, it will be necessary to have in connection with the laboratory a sea pond similar to the one erected for the United States Fish Commission at Wood's Holl. Without this, it will be impossible to carry on fish-hatching experiments on a sufficiently large scale to obtain any practical results. Fortunately a suitable pond could be easily constructed at a small cost within a few yards of the laboratory. At present observations are being made on the eggs of various species of food fishes, and it is proposed at an early date to obtain the assistance of a naturalist to carry on the work of this laboratory.

At this station there will be special facilities for studying the summer herring fishing in Lochfyne, and for collecting information likely to throw some light on the cause of the fluctuations in this important fishery. The position of this laboratory renders it easily possible, with the aid of a good steam yacht, to embrace the whole area of the Firth of the Clyde. The Tarbert laboratory has been specially constructed to suit this work, and it is proposed to direct attention chiefly to the following questions:—The nature of the eggs of fishes, and of the spawning process, the rate of growth of the chief food fishes, and the nature of the food of the young and adult forms. Experiments will also be made as to the possibility of transporting fish and fish eggs to the colonies and elsewhere, and as to the possibility of introducing useful food fishes from other countries.

Development
of the Herring.

Owing to the late period at which the special grant for scientific investigations was received, and to the necessary arrangements which had to be made in order to carry on the work on a broader basis, it was impossible to commence any important observations until the end of February. About that time, however, Mr Brook's assistant, Mr Binnie, was instructed to join H.M.S. 'Jackal,' and collect a number of spawning herring from the Ballantrae Banks, and deposit them in the Rothesay Aquarium for further

study. This was accordingly done, and with the assistance of Lieut. Commander Osborne, R.N., the fish were received in safety on the evening of the 13th March. Various experiments were tried in the artificial fertilisation of the eggs, most of which proved very successful. It was found that whereas the milt of the herring only remains active for a short time after the death of the fish, the roe retains its vitality for a considerable time afterwards. A number of eggs taken from a herring which had been dead 48 hours were successfully hatched. These experiments will, however, be described in detail in Mr Brook's papers on the subject, the first of which is appended to this Report, and others will be presented to the Board during the summer and autumn. Mr Brook was able in the main to confirm the observations of Kuppfer on the development of the herring. Various minor points of difference, however, appear to exist, and these will be treated of fully in the papers referred to.

In the beginning of March a number of cod-fish which had been for some months in the Rothesay Aquarium began to spawn. It had been noticed for two months previously that many of the fish were distended as if with spawn, but as no fish had ever been known to spawn in the Aquarium, unless recently introduced, the authorities there were not inclined to believe that the fish were reaching maturity. However, a few days afterwards eggs were observed floating on the surface of the water in an early stage of development, and about the same time the fish refused food. Professor Ewart and Mr Brook then made an investigation of the spawning process of the cod, as far as it could be observed. It was noticed that the fish during the spawning period often lay close together at the bottom of the tank; but, notwithstanding this, it seems from the observations made, that the spawn is shed when the fish are swimming about in the water, the eggs being fertilised as they rise to the surface. The eggs when newly laid float, whether fertilised or not; but in the latter event they die, and sink to the bottom in from 12 to 14 hours. The milt also has a tendency to rise, and to diffuse through the water so as to give it a slightly milky appearance. A detailed account of these experiments will be found in the Appendix.

The Board is also pleased to be able to state that the Directors of the Rothesay Aquarium have very kindly placed the tanks in their institution at the service of the Board for experimental work. This will prove of great assistance in the study of the life history of various food fishes, particularly in the winter months. Important results have already been arrived at with regard to the development of the herring, which will appear in a future Report.

Until a suitable steam tender is attached to the Fishery cruiser stationed at Rothesay, Professor Ewart has sent his small steam yacht to Tarbert to admit of dredging and other operations being carried on.

It was mentioned in the last Report that some progress had been made in studying the food of the herring. Many hundreds of stomachs have been examined and the contents noted. A paper by Mr Brook, on the 'Food of the Herring,' is now in hand, and will be completed during the summer.

Spawning of
the Cod.

Rothesay
Aquarium
placed at the
service of the
Board.

Enquiry into
the food of
the Herring.

Material
collected by
Fishery
Officers.

During the past year a circular was issued to the fishery officers giving them further instructions for the collection of material for studying the food and growth of fishes. In response to this circular, a large amount of material has been received from various stations around the coast, and it will now be possible to begin a comparative study of the food of the following fishes:—Cod, codling, haddock, whiting, saith, coal-fish, ling, sea-trout, mackerel, sole, flounder, halibut, plaice, and brill. It will, however, be some time before all the material collected can be worked up, and it will also be necessary to carry on these investigations over a period of at least twelve months before a satisfactory report can be prepared. The fishery officers have also sent in a number of fishes, crustacea, &c., for identification. Amongst these may be mentioned a fine specimen of the Great Fork Beard or Hakes Dame, caught by a trawler 20 miles off St Abb's Head, in about 40 fathoms of water, in March last. The fishery officer at Berwick forwarded to the Board a very large specimen of the lumpsucker *Cyclopterus lumpus*, measuring $19\frac{1}{4}$ inches by $13\frac{1}{4}$ inches, and a fine specimen of the Tubfish *Trigla hirundo*. The fishery officer at Lybster forwarded part of a haddock's stomach in which a large sand-eel was embedded. A note on this specimen by Dr Barrett will be found in the Appendix. There is also a note by Dr Woodhead on a caseous tumour in the hake. The specimen was obtained by one of the Newhaven trawlers in February last.

The investigation as to the influence of fungi and other minute organisms on the fish supply, has been undertaken by Professor Greenfield. A note indicating the methods followed in prosecuting this inquiry, will be found in the appendix. The first part of the report on this subject, will be presented to the Board during the summer.

Cromarty
Laboratory.

In addition to the St Andrews and Tarbert temporary stations, there is in the Cromarty Firth a small laboratory, which has been put at the service of the Board by Professor Ewart, which will be available for carrying on investigations during the summer and autumn. This will be a convenient centre from which to test the influence of trawling in the inshore waters of the Moray Firth. It is also proposed to introduce into the comparatively restricted waters of the Cromarty Firth a large number of artificially hatched herring and other fish, in order to determine whether it is possible to restock deserted fishing grounds, and increase the number of fish by artificial means in the territorial waters.

Proposed
Laboratory on
the Firth of
Forth.

In order to carry on investigations as to the influence of trawling, more especially in the territorial waters in the vicinity of the Firth of Forth, it will be necessary to establish a marine laboratory near the mouth of the Firth. As soon as this laboratory is provided the Board will be in a position to study the development and rate of growth of the cod, haddock, whiting, and other round fish. To admit of a complete account of the life history and habits of these and other fish, a small sea pond will require to be provided at the outset. As pointed out in the Report of the Royal Commission, on Trawling, a satisfactory knowledge of the real influence of this method of fishing can only be arrived at after a complete series of

scientific observations have been made, which have extended over a long period, and which have been obtained by the aid of every modern appliance.

The Board would again point out that the marine police superintendence with which it is charged cannot be efficiently carried on unless the sailing cruiser belonging to the Board and H.M.S. 'Jackal' are superseded by two steam-vessels, each provided with a suitable steam-tender; one of these vessels to be adapted for the purposes of dredging, and the tenders adapted for carrying on the inshore scientific work referred to above.

ESTIMATED PRODUCE AND VALUE OF THE FISHERIES OF SCOTLAND.

The total estimated produce and value of the Sea and Salmon Fisheries of Scotland, for the year 1884, are as follow:—

CURED FISH—

Herrings, 1,697,077½ barrels, at 25s. per barrel,	£2,121,346 11 3	Cured Fish.
Cod, Ling, and Hake 124,506½ cwts., dried, at 24s. per cwt.,	149,407 16 0	
Do., 5907½ barrels in pickle, at 30s. per barrel,	8,861 5 0	
Total Value of Cured Fish,	£2,279,615 12 3	

FISH SOLD FRESH—

<i>White Fish—</i>			Fish sold Fresh.
Haddocks,	464,049 cwts.,	£300,712 0 0	White Fish.
Herrings,	414,657 „	150,720 0 0	
Cod, Ling, and Hake	175,746 „	97,443 0 0	
Tusk and Saith,	40,969 „	10,481 0 0	
Whittings,	71,507 „	32,808 0 0	
Sprats,	89,787 „	5,232 0 0	
Mackerel,	14,667 „	5,286 0 0	
Turbot,	4,234 „	9,368 0 0	
Halibut,	23,050 „	17,824 0 0	
Flounders,	72,758 „	47,723 0 0	
Skate,	61,982 „	14,171 0 0	
Soles and other kinds of White Fish, 60,636 „		24,727 0 0	
Total Produce and Value of White Fish sold Fresh,	1,494,042 cwts.,	£716,395 0 0	

Shell Fish—

Lobsters,	£29,942 0 0	Shell Fish.
Crabs,	23,799 0 0	
Mussels,	16,062 0 0	
Oysters and other kinds of Shell Fish, 11,136 0 0		
Total Value of Shell Fish,	80,939 0 0	
Total Value of Fish Sold Fresh,	797,234 0 0	

SALMON, 275,000 0 0 Salmon.

GROSS TOTAL estimated value of the Fisheries of Scotland for the year 1884, £3,351,849 12 3 Total value of Fisheries.

SUMMARY.

Upon comparing the accounts of 1884 with those of 1883, it will be seen—

Totals of Herrings cured, branded, and exported.

That, in the herring fishery, the total quantity of herrings cured in 1884 was 1,697,077½ barrels, valued at £2,121,346, 11s. 3d.; the total quantity branded, 653,425 barrels; and the total quantity exported, 1,185,220½ barrels,—being an increase on the preceding year of 427,664½ barrels in the quantity cured; 182,429½ barrels in the quantity branded; and of 294,460 barrels in the quantity exported.

Totals of Cod, Ling, and Hake cured and exported.

That, in the cod, ling, and hake fishery, 124,506½ cwts. were cured dried, and 5907½ barrels cured in pickle, valued at £158,269, 1s.; and that the quantity exported was 56,716½ cwts. cured dried,—being an increase on the preceding year of 4170½ cwts. in the quantity cured dried, a decrease of 1402½ barrels in the quantity cured in pickle, and an increase of 190½ cwts. in the quantity exported.

Value of Fish sold fresh. Total value of Fisheries.

That the estimated value of white fish sold fresh in 1884 was £716,295; of shell fish, £80,939; and of salmon, £275,000,—the gross total estimated value of the fisheries of Scotland, in cured fish and fish sold fresh, being £3,351,849, 12s. 3d.

Number of Boats and Vessels and Fishermen.

That the number of fishing boats and beam trawl vessels in Scotland was 15,445, and of fishermen and boys, 49,860; and that the estimated value of the fishing boats and beam trawl vessels, and of nets and lines used in the herring, cod, ling, and other sea fisheries, was £1,802,886,—being an increase on the preceding year of 151 boats and beam trawl vessels, and 138 fishermen and boys, and of £148,726 in the estimated value of boats and vessels, nets and lines.

Value of Boats, Vessels, Nets, and Lines.

Total number of Persons employed.

That the total number of persons employed in Scotland last year in connection with the fishing industry was estimated at 103,804, being an increase on the preceding year of 1965.

We have the honour to be,

SIR,

Your most obedient Servants,

(Signed) THOMAS J. BOYD, *Chairman.*
JOHN GUTHRIE SMITH, *Deputy-Chairman.*
GEO. H. M. THOMS.
ALEXR. FORBES IRVINE.
J. R. G. MAITLAND.
S. WILLIAMSON.
J. COSSAR EWART.
J. MAXTONE GRAHAM.
JAS. J. GRIEVE.

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APPENDIX A.—TABLE I.

HERRING FISHERY.—ACCOUNT of the Number of Vessels fitted out in SCOTLAND for the HERRING FISHERY in the Year 1884; the Districts from which fitted out; the Tonnage and Number of Men; the Netting, Salt, and Barrels Shipped; and the Barrels of White Herrings Cured on Board.

DISTRICTS.	Vessels.	Tonnage.	Men.	Netting.	Salt.	Barrels.	Herrings Cured on Board.					Total Cured on Board of Vessels.
							Gutted.		Ungutted.			
							Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but <i>not</i> within 24 hours after being caught.	Barrels.	Barrels.	Barrels of Bulk.	
Leith.	3	228	33	143,050	2,490	Number.	Barrels.	Barrels.	Number.	Number.	Barrels.	
Aberdeen.	1	81	13	31,200	1,500	1,257	319	...	104	...	423	
Peterhead.	3	198	35	180,000	4,560	1,650	526	...	104	...	630	
Shetland Isles.	2	149	22	76,250	1,390	1,407	1,210	197	...	...	1,407
Stornoway.	13	571	70	138,250	12,020	660	420	...	65	...	485	
Loch Broom.	12	553	86	10,000	7,130	5,894	1,899½	...	...	10	1,909½
Loch Carron and Skye.	24	802½	104	230,000	17,232	873	375	...	...	8,037	8,412
Fort William.	18	260	60	101,100	1,590	8,721	3,902	...	155	107	4,164	
Campbeltown.	1	29	5	24,000	160	1,021	751	27	...	...	778
Inveraray.	15	554	92	81,000	3,010	47	32	...	...	...	32
Rothsay.	12	162	40	55,000	2,693	463	1,147	...	419	9,838	11,404	
Greenock.	3	98	14	...	3,300	1,331	654	38	...	...	687
Total.	117	3,635½	574	1,069,850	57,075	1,619	11,405½	...	130	472	12,007½	
						23,943	22,641	257	977	18,464	42,339	

Note.—The above 117 Fishing Vessels made 136 Voyages.

Fishery Board for Scotland.
Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

APPENDIX A.—TABLE II.

HERRING FISHERY.—ACCOUNT of the Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND by Fish-Curers on Shore in the Year 1884; and the Districts in which Cured, distinguishing the Herrings Cured Gutted from those cured Ungutted.

DISTRICTS.	Herrings Cured Gutted.		Herrings Cured Ungutted.		Total Cured on Shore.
	Gutted and Packed within 24 hours after being caught.	Gutted and Packed; but <i>not</i> within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	<i>Barrels.</i>	<i>Barrels.</i>	<i>Number.</i>	<i>Number.</i>	<i>Barrels.</i>
Eyemouth, . . .	48,459	9,573	13,477	16,842	88,351
Leith, . . .	1,206	...	168	3,690½	5,064½
Anstruther, . . .	2,167	350	369	7,664	11,050
Montrose, . . .	29,705	4,510	2,771	2,189	39,175
Stonehaven, . . .	14,492½	1,299	875	2,328½	18,995½
Aberdeen, . . .	57,989	4,060	9,411	17,623	89,083
Peterhead, . . .	280,438	4,528	2,359	9,244	296,569
Fraserburgh, . . .	323,040	3,573	193	21,562	348,368
Banff, . . .	40,183	...	604	...	40,787
Buckie, . . .	17,383	474	609	2,953	21,419
Findhorn, . . .	2,738	5	303	50	3,096
Cromarty, . . .	1,039	...	...	...	1,039
Helmsdale, . . .	8,015	...	4	1,147	9,166
Lybster, . . .	5,347	...	...	...	5,347
Wick, . . .	116,903	2,987	1,725	5,525	127,140
Orkney Isles, . . .	47,051	795	353	125	48,824
Shetland Isles, . . .	292,073	935	...	6,624	299,632
Stornoway, . . .	88,736½	172	...	20,987½	109,896
Loch Broom, . . .	6,834	244	654	464	8,196
Loch Carron & Skye, . . .	6,232	...	642	119	6,993
Fort William, . . .	3,415	...	...	532	3,947
Campbeltown, . . .	706	...	...	40,215	40,921
Inveraray, . . .	1,053	...	...	9,058	10,111
Rothsay, . . .	605	...	38	2,997	3,640
Greenock, . . .	...	...	...	3,909½	3,909½
Ballantrae, . . .	...	...	...	14,019	14,019
Total, . . .	1,895,810	33,505	35,555	189,868½	1,654,788½

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

APPENDIX A.—TABLE III.

HERRING FISHERY.—ACCOUNT of the Total Number of Barrels of WHITE HERRINGS Cured or Salted in SCOTLAND, on Board of Vessels and on Shore, in the Year 1884; distinguishing the Herrings Cured Guttled from those Cured Unguttled.

DISTRICTS.	Herrings Cured Guttled.		Herrings Cured Unguttled.		Total Herrings Cured on board of Vessels and on Shore.
	Guttled and Packed within 24 hours after being caught.	Guttled and Packed; but not within 24 hours after being caught.	Barrels.	Barrels of Bulk.	
	<i>Barrels.</i>	<i>Barrels.</i>	<i>Number.</i>	<i>Number.</i>	<i>Barrels.</i>
Kyemouth, . . .	48,459	9,578	18,477	16,842	88,351
Leith, . . .	1,525	...	272	3,690½	5,487½
Anstruther, . . .	2,167	350	869	7,664	11,050
Montrose, . . .	29,705	4,510	2,771	2,189	39,175
Stonehaven, . . .	14,492½	1,299	875	2,328½	18,995½
Aberdeen, . . .	58,515	4,060	9,515	17,623	89,713
Peterhead, . . .	281,648	4,725	2,359	9,244	297,976
Fraserburgh, . . .	323,040	3,578	198	21,562	348,368
Banff, . . .	40,183	...	604	...	40,787
Buckie, . . .	17,383	474	609	2,953	21,419
Findhorn, . . .	2,738	5	303	50	3,096
Cromarty, . . .	1,039	...	...	...	1,039
Helmsdale, . . .	8,015	...	4	1,147	9,166
Lybster, . . .	5,347	...	...	...	5,347
Wick, . . .	116,908	2,987	1,725	5,525	127,140
Orkney Isles, . . .	47,051	795	853	125	48,824
Shetland Isles, . . .	292,493	935	65	6,624	300,117
Stornoway, . . .	90,636	172	...	20,997½	111,805½
Loch Broom, . . .	7,209	244	654	8,501	16,608
Loch Carron & Skye, . . .	10,184	...	797	226	11,157
Fort William, . . .	4,166	27	...	532	4,725
Campbeltown, . . .	738	...	...	40,215	40,953
Inveraray, . . .	2,200	...	419	18,896	21,515
Rothsay, . . .	1,259	38	38	2,997	4,327
Greenock, . . .	11,405½	...	180	4,881½	15,917
Ballantrae, . . .	...	...	...	14,019	14,019
Total, . . .	1,418,451	33,762	36,532	208,332½	1,697,077½

SUPPLEMENTARY NOTE, showing the Number of Barrels of WHITE HERRINGS Cured or Salted on the West Coast of Scotland in the Year 1884, stated according to the Districts where the Herrings were caught.

DISTRICTS.	Barrels.
Stornoway, . . .	116,010½
Loch Broom, . . .	16,700
Loch Carron & Skye, . . .	17,538
Fort William, . . .	7,906½
Campbeltown, . . .	40,921
Inveraray, . . .	19,648
Rothsay, . . .	4,154
Greenock, . . .	4,129½
Ballantrae, . . .	14,019
Total, . . .	241,026½

APPENDIX A.—TABLE IV.

HERRING FISHERY.—ACCOUNT of the Total Number of Barrels of WHITE HERRINGS Branded in SCOTLAND in the Year 1884; and of the Brandings in each District.

DISTRICTS.	Total Branded.
Eyemouth,	7,357½
Leith,	816
Anstruther,	561
Montrose,	24,997
Stonehaven,	11,513
Aberdeen,	88,893
Peterhead,	169,205½
Fraserburgh,	147,210
Banff,	25,786
Buckie,	12,257½
Findhorn,	2,063½
Cromarty,	763½
Helmsdale,	7,051½
Lybster,	4,722
Wick,	60,792½
Orkney Isles,	22,230½
Shetland Isles,	117,205
Total,	*653,425

* Of this number, 197,096 Barrels were branded Crown FULL.
 " 323,644 " were branded " MATIES.
 " 71,662 " were branded " SPENT.
 " 61,023 " were branded " MIXED.
 " ... " were branded " REPACKED.
653,425 Barrels. The Fees thereon amounted to £10,890 8 4
 Bank Interest, 19 11
 Total Receipts, £10,891 8 3

NOTE, showing the Total Number of Barrels in the foregoing Account Branded 'Full,' 'Maties,' or 'Spent.'

DISTRICTS.	Number of Barrels assorted and Branded.		
	Crown Full.	Maties.	Spent.
Eyemouth,	4,895½	1,538	1,008
Leith,	707	35	74
Anstruther,	202	134	145
Montrose,	10,485	6,540½	7,946½
Stonehaven,	4,663½	2,995½	3,362
Aberdeen,	14,839½	13,079½	9,268
Peterhead,	58,256½	96,100	12,513½
Fraserburgh,	33,175½	96,057½	12,947½
Banff,	4,340	17,564½	1,374
Buckie,	3,035	7,231½	1,244
Findhorn,	493½	1,533	86
Cromarty,	211½	543½	8½
Helmsdale,	2,697½	3,505	632
Lybster,	1,676½	2,881½	54
Wick,	12,976	36,110½	4,273½
Orkney Isles,	5,766½	11,634	2,322
Shetland Isles,	39,175	26,165½	14,453½
Total,	197,096	323,644	71,662

Fishery Board for Scotland,
 Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

APPENDIX A.—TABLE V.

HERRING FISHERY.—ACCOUNT of the Number of Barrels of WHITE HERRINGS Exported from SCOTLAND in the Year 1884; distinguishing the Export to Ireland, to the Continent, and to places out of Europe; distinguishing also Herrings Cured Gutted from Herrings Cured Ungutted; and Herrings Bung-Packed from Herrings Repacked.

BARRELS OF HERRINGS EXPORTED.									
DISTRICTS.	To Ireland.		Barrels of Bulk.	To the Continent.		To Places out of Europe.		Total Exported.	
	Bung-Packed.			Bung-Packed.		Repacked.			
	Gutted.	Ungutted.	Gutted.	Ungutted.	Gutted.	Gutted.			
	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.			
Eyemouth,	5,960	296	Number.	29,136½	...	...	Barrels.	35,890½
Leith, . . . . .	...	...	...	44,228½	...	...	...	44,228½
Anstruther, . . . . .	...	...	...	799	...	...	...	799
Montrose, . . . . .	...	...	...	80,149½	...	...	...	80,149½
Stonehaven, . . . . .	...	...	...	9,802	7	...	...	9,809
Aberdeen, . . . . .	...	...	...	64,641½	...	504½	...	65,196
Peterhead,	1,280	...	...	238,191	...	...	...	239,471
Fraserburgh, . . . . .	...	...	...	234,923½	...	...	...	234,923½
Banff, . . . . .	...	...	...	80,413	...	...	...	80,413
Buckie, . . . . .	...	...	...	12,592½	...	...	...	12,592½
Findhorn, . . . . .	...	...	...	1,912½	...	...	...	1,912½
Cromarty, . . . . .	...	...	...	783½	...	...	...	783½
Helmsdale, . . . . .	...	...	...	5,654	...	...	...	5,654
Lybster, . . . . .	...	...	...	5,000	...	...	...	5,000
Wick,	11,845	286	170	96,564½	...	...	...	108,876½
Orkney Isles,	8,627½	...	135	34,686	...	...	...	43,458½
Shetland Isles,	1,480	...	...	249,962½	...	...	...	251,442½
Sornoway, . . . . .	...	...	...	59,592½	...	...	...	59,592½
Loch Broom,	190	...	100	...	...	...	...	190
Loch Carron and Skye,	3,987	650	294	...	...	410	...	5,841
Greenock, . . . . .	...	...	...	...	...	...	...	...
Total,	38,869½	1,241	699	1,148,949½	7	460	504½	1,185,220½	

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

SUPPLEMENTARY NOTE, showing the Ports or Places to which the Herrings Exported to the Continent were Shipped.

STATIONS.	BARRELS OF HERRINGS EXPORTED.															Total Exported to the Continent.	
	Russia.					Germany.					Holland.		Other Places on the Continent.				
	Helsing-fors.	Peters-burg.	Pernau.	Riga.	Libau.	Memel.	Königs-berg.	Elbing.	Danzig.	Stettin.	Hamburg.	Bremen.		Rotter-dam.	Amster-dam.		
Odesa.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	Barrels.	
Eyemouth,	29,124
Leith,	...	1,228	...	80	...	...	2,345	...	5,737	11,494	38,471	774	...	...	...	44,224
Austruben,	1,500	...	799	12,814	...	...	...	...	...	30,149	
Montrose,	4,364	...	3,493	1,915	1,268	...	...	...	...	9,880	
Stonhaven,	655	...	...	...	13,984	...	17,155	18,784	11,647	...	...	...	...	64,611	
Aberdeen,	50	...	...	...	1,776	...	43,251	...	37,484	60,909	37,915	2,228	...	...	...	233,191
Peterhead,	2,153	80,718	3,944	...	37,070	62,166	29,763	1,723	...	...	...	224,234	
Fraserburgh,	12,431	80,743	3,633	54,537	836	14,028	16,398	...	...	...	...	39,413	
Baird,	1,069	...	5,377	2,644	...	...	...	...	...	15,892	
Buchan,	804	3,777	...	1,396	614	...	...	...	...	...	1,915	
Findhorn,	754	...	...	...	...	...	754	
Cronarty,	313	3,673	1,170	...	...	...	4,844	
Holmsdale,	979	2,080	1,096	...	...	...	5,000	
Lybster,	915	...	39,834	36,377	16,723	...	...	...	...	94,644	
Wick,	1,628	2,667	...	8,674	...	29,834	20,398	2,394	...	...	...	...	34,698	
Orkney Isles,	1,320	373	...	3,177	...	7,479	123,486	37,769	...	...	...	...	246,963	
Shetland Isles,	700	8,149	...	33,371	...	43,363	9,333	6,401	...	...	...	...	49,493	
Stornoway,	...	44,185	...	...	...	...	...	...	713	220,223	391,132	186,394	4,870	674	113	1,148,961
Total,	50	50	45,423	655	18,900	96,128	12,564	173,491	826	220,223	391,132	186,394	4,870	674	113	1,148,961	

Fishery Board for Scotland.
Edinburgh, 14 May 1885.

DUGALD GRAHAM, Secretary.

APPENDIX A.—TABLE VI.

HERRING FISHERY.—ABSTRACT showing the Total Quantity of WHITE HERRINGS Cured, Branded, and Exported, year by year, in so far as brought under cognisance of Fishery Officers, from the 1st of June 1809 to the 31st of December 1884; distinguishing the Export to Ireland, to the Continent, and to places out of Europe.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	<i>Barrels.</i>	<i>Bls. or Crans.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Bls. or Crans.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Barrels.</i>
Period extending from 1st June 1809 to 31st April 1810.	42,548	47,637½	90,184½	24,701	28,014	...	7,334	26,948
Year ended 31st April 1811.	66,480	26,897½	91,877½	24,003½	28,313	...	9,271	28,183
Year ended 31st April 1812.	73,515½	20,004	111,519½	26,480	20,417½	4,780	27,672½	63,870
Year ended 31st April 1813.	80,000½	63,567½	123,468½	70,077½	27,880	11,046½	46,699	109,726½
Year ended 31st April 1814.	52,331½	27,611	110,543½	26,184½	43,001½	26,948	51,299	118,408½
Year ended 31st April 1815.	106,373½	24,767	160,138½	83,376	46,628½	26,391	54,775½	141,203½
Year ended 31st April 1816.	126,361	20,670½	167,631½	116,486	29,462½	16,563	62,662½	107,668
Year ended 31st April 1817.	156,776	24,567½	179,343½	140,616½	24,241	44,483½	57,246	126,626½
Year ended 31st April 1818.	204,376½	26,459½	227,691	163,064½	23,866½	48,806	66,967	162,329½
Year ended 31st April 1819.	208,777½	27,116½	240,894	270,672½	89,704	22,389	86,126	227,162
Year ended 31st April 1820.	247,190½	26,201	282,491½	269,703½	101,109½	64,203½	86,104	263,516
Year ended 31st April 1821.	413,206	26,887½	442,194½	263,873	126,446	89,634	79,836½	294,904½
Year ended 31st April 1822.	291,626½	24,867½	316,524½	263,904½	102,719	24,722	77,685	214,946
Year ended 31st April 1823.	225,037	22,832	246,869	203,110	56,638	23,002½	75,914½	170,445
Year ended 31st April 1824.	325,450	56,740½	392,190½	299,631	116,747½	40,231	82,652	239,630½

APPENDIX A.—TABLE VI.—Continued.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungritted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	Barrisdale.	Blk. or Green.	Barrisdale.	Barrisdale.	Blk. or Green.	Barrisdale.	Barrisdale.	Barrisdale.
Year ended 5th April 1885.	308,397	44,393	347,084	370,844	96,493	24,094	70,377	302,014
Year ended 5th April 1886.	340,118	39,113	379,231	394,439	131,893	23,167	67,519	317,073
Year ended 5th April 1887.	359,171	39,394	398,465	333,006	79,735	16,701	70,370	196,406
Year ended 5th April 1888.	339,390	60,413	399,778	370,317	109,103	34,493	78,061	311,689
Year ended 5th April 1889.	300,343	55,737	356,079	334,337	107,651	23,390	69,944	306,674
Year ended 5th April 1890.	290,993	48,634	339,627	310,413	89,693	34,303	67,673	181,664
Year ended 5th April 1891.	371,096	69,374	440,370	337,006	130,300	61,654	73,947	364,903
Year ended 5th April 1892.	313,113	49,547	363,660	137,333	138,468	31,100	67,941	317,493
Year ended 5th April 1893.	353,694	63,379	416,964	166,353	114,137	47,564	58,991	330,694
Year ended 5th April 1894.	333,677	68,832	451,531	178,000	149,344	54,833	64,867	373,084
Year ended 5th April 1895.	317,343	60,074	377,317	86,079	73,960	34,060	50,794	188,804
Year ended 5th April 1896.	339,334	36,390	407,614	192,317	168,960	45,451	54,993	373,394
Year ended 5th April 1897.	390,169	107,690	397,899	114,193	102,963	44,777	39,430	189,364
Year ended 5th April 1898.	382,400	136,374	507,774	141,433	139,096	27,363	26,674	243,143
Year ended 5th April 1899.	363,339	173,390	536,699	139,639	149,926	64,970	24,394	330,730
Year ended 5th April 1890.	406,379	138,664	545,945	152,331	157,349	62,315	13,447	333,623
Year ended 5th April 1891.	431,137	136,103	567,393	154,189	150,617	90,931	9,668	340,137
Year ended 5th April 1892.	489,030	177,624	667,345	190,934	137,943	91,063	4,713	394,736

APPENDIX A.—TABLE VI.—Continued.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Cutted.	Unsalted including Bulk.	Else. or Oversea.		To Ireland.	To the Continent.	To places out of Europe.	
	<i>Barrels.</i>	<i>Elts. or Oversea.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Elts. or Oversea.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Barrels.</i>
Year ended 5th April 1842,	442,290	181,129½	622,419½	182,713	165,237½	150,156½	6,264½	291,800½
Year ended 5th April 1844,	478,566½	191,808	669,374½	182,968	137,770	181,943	2,792½	312,616½
Period extending from 5th April 1844 to 5th January 1845,	268,312	122,729½	391,041½	140,622	120,298	142,754	2,326½	266,372½
Year ended 5th January 1846,	411,271	121,275	532,546	142,472½	127,027½	113,678	2,488½	242,194
Year ended 5th January 1847,	414,915½	122,622½	537,538½	156,278½	102,585	148,262½	4,765½	255,714
Year ended 5th January 1848,	272,969½	129,754	402,723½	146,600½	102,690	142,632	4,959	250,181
Year ended 5th January 1849,	292,827	251,541½	544,368½	153,944	79,292½	168,049	3,632½	249,994
Year ended 5th January 1850,	507,094½	262,072½	770,167½	212,266½	78,892½	227,108	4,258½	240,266½
*Year ended 5th January 1851, for Scotland and the Isle of Man only,	272,127	166,622½	438,749½	172,994½	64,128	158,403	2,267	266,908
Year ended 5th January 1852, for do.	417,292½	176,727½	594,020½	201,626½	81,240½	182,659	205	264,204½
Year ended 31st December 1852, for do.	275,608	122,094½	397,702½	169,169½	60,414	221,279	1,122	262,526
Year ended 31st December 1853, for do.	260,267	217,072½	477,339½	262,196½	94,229	242,882½	4,486½	242,620½
Year ended 31st December 1854, for do.	468,279½	177,892½	646,172½	211,644	121,882½	227,892½	1,919½	361,692½
Year ended 31st December 1855, for do.	262,715½	128,982½	391,698½	280,531½	97,277	244,029	668	442,264
Year ended 31st December 1856, for do.	466,429½	142,659	609,088½	222,281	69,670½	256,741	1,199½	247,611½
Year ended 31st December 1857, for do.	465,292½	112,231½	577,524½	218,992	56,554	207,274½	1,261	267,160½

*The Collection of Returns for England ceased from the 5th of January 1850, and for the Isle of Man from the 1st of January 1869.

APPENDIX A.—TABLE VI.—Continued.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Cutted.	Unsalted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
Year ended 31st December 1855, for Scotland and the Isle of Man only.	Barrels. 670,890½	Blk. or Casks. 155,790½	Barrels. 626,104	Barrels. 283,374	Blk. or Casks. 79,864	Barrels. 269,319	Barrels. 1,381½	Barrels. 280,304½
*Year ended 31st December 1859, for do.	581,909½	110,438	491,467½	148,676	68,862	303,849½	748	373,970½
Year ended 31st December 1860, for do.	696,614½	184,779½	661,189½	221,915½	86,413	221,401½	146	377,970½
Year ended 31st December 1861, for do.	519,173	149,654½	668,828½	268,247	81,694½	206,324½	384	390,312½
Year ended 31st December 1862, for do.	656,046	174,856	830,904	246,713	70,879½	423,182½	847½	494,910
Year ended 31st December 1863, for do.	507,323	147,694½	654,816½	276,890½	72,074½	323,074½	2,612½	407,761½
Year ended 31st December 1864, for do.	475,781½	164,862½	643,650½	217,392	56,430½	307,262	1,806	364,507½
Year ended 31st December 1865, for do.	470,669½	151,304½	621,763	216,786	42,063	309,636	1,012	352,701
Year ended 31st December 1866, for do.	497,814½	160,322½	658,146½	246,510	47,319	328,372½	4,474½	380,066
Year ended 31st December 1867, for do.	631,766½	193,629½	825,599	317,431	42,364½	432,994½	3,244½	478,704½
Year ended 31st December 1868, for do.	445,469½	206,906½	651,422½	299,462½	48,414½	323,479½	1,664½	368,744½
†Year ended 31st December 1869, for Scotland only	488,331	186,313	675,145	244,522½	32,342½	346,792½	2,197½	361,322½
Year ended 31st December 1870, for do.	687,069½	174,101	863,169½	299,331½	41,294	484,064	2,270	490,546
Year ended 31st December 1871, for do.	668,459½	156,962½	825,475½	246,632½	46,247	502,534½	2,734	551,605½
Year ended 31st December 1872, for do.	671,706½	168,166	773,639½	422,731½	24,147	523,540½	1,949½	549,631
Year ended 31st December 1873, for do.	795,973	142,331½	938,283½	435,374½	32,465½	633,681	1,561½	638,068
Year ended 31st December 1874, for do.	887,002½	113,569½	1,000,561	517,559½	28,137½	706,967½	2,309½	737,314½

* By Act 31st and 32nd Vict. cap. 69 (1868), there was imposed upon the Branding of Barrels and Half-Barrels of Herrings a Fee of Fourpence per Barrel and Two pence per Half-Barrel.

† The Collection of Returns for England ceased from the 6th of January 1869, and for the Isle of Man from the 1st of January 1869.

APPENDIX A.—TABLE VI.—Continued.

PERIODS.	Total Quantity of Herrings Cured.			Total Quantity of Herrings Branded.	Total Quantity of Herrings Exported.			Grand Total Exported.
	Gutted.	Ungutted including Bulk.	Total Cured.		To Ireland.	To the Continent.	To places out of Europe.	
	<i>Barrels.</i>	<i>Bls. or Crans.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Bls. or Crans.</i>	<i>Barrels.</i>	<i>Barrels.</i>	<i>Barrels.</i>
Year ended 31st December 1875, for Scotland only,	884,832½	108,187½	945,980	832,789½	33,494	624,137½	3,399	600,970½
Year ended 31st December 1876, for do.	486,286½	111,969	598,197½	362,970½	20,383	378,740	1,360½	400,493½
Year ended 31st December 1877, for do.	716,871½	130,847½	847,718½	397,796	16,065½	543,908½	1,992	545,863½
Year ended 31st December 1878, for do.	771,566	134,312	905,768	456,708	17,445½	606,969½	2,519	608,934
Year ended 31st December 1879, for do.	656,991	186,806	841,796	342,323	8,857½	536,380½	766½	545,893½
Year ended 31st December 1880, for do.	1,324,186½	249,401½	1,473,680½	689,286	32,462½	976,300½	1,028½	1,009,811½
Year ended 31st December 1881, for do.	915,098	196,073	1,111,156½	494,182½	33,469½	711,448	972½	745,879½
Year ended 31st December 1882, for do.	860,764½	302,318	1,383,972½	462,612½	40,377	782,576½	3,029½	826,862½
Year ended 31st December 1883, for do.	1,083,067	226,226½	1,369,413½	479,996½	36,870	863,644½	1,246	880,760½
Year ended 31st December 1884, for do.	1,456,313	244,864½	1,697,077½	632,426	36,299½	1,148,966½	964½	1,186,290½

N.B.—In the Six Years ended 5th April 1815, the Bounty on Herrings Cured Gutted was 2s. per Barrel, while there was a Bounty at the same time of 3s. 6d. per Barrel, payable by the Excise on the Exportation of Herrings, whether Cured Gutted or Ungutted, but which ceased on the 1st June 1815; in the Eleven Years ended 5th April 1828, the Bounty on Herrings Cured Gutted was 4s. per Barrel; in the Four succeeding Years the Bounty was reduced 1s. per Barrel each Year till the 5th of April 1830, when it ceased altogether.

Fishery Board for Scotland,
Edinburgh, 1st May 1884.

DUGALD GRAHAM, Secretary.

APPENDIX B.—TABLE I.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the Number of Vessels fitted out in SCOTLAND for the COD and LING Fishery, in the Year 1884; of the Tonnage of the Vessels, and the Number of Men; also of the Quantity of COD, LING and HAKE Cured on Board; distinguishing whether Cured Dried or Cured in Pickle.

DISTRICTS.	Vessels.	Tonnage.	Men.	Total Quantity of Cod, Ling and Hake Cured on board of Vessels.	
				Number of Fish.	Cured Dried.
	<i>Number.</i>	<i>Tons.</i>	<i>Number.</i>	<i>Number.</i>	<i>Cwts.</i>
Fraserburgh, . .	11	196	66	40,818	1,592
Orkney Isles, . .	20	1,281	214	185,836	5,426
Shetland Isles, . .	35	1,708	377	456,044	11,754
Stornoway, . .	1	55	10	2,576	112
Total, . .	67	3,235	667	684,769	18,884

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE II.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the COD, LING and HAKE taken at the Cod and Ling Fishery in SCOTLAND by Open Boats and Cured on Shore, in the Year 1884; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling and Hake Cured on Shore.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	<i>Number.</i>	<i>Cwts.</i>	<i>Barrels.</i>
Anstruther,	117,215	4,987	212
Montrose,	78,947	2,606	2
Stonehaven,	20,436	657	...
Aberdeen,	87,248	1,236	7
Peterhead,	81,846	601	540
Fraserburgh,	53,817	1,648	91
Banff,	77,759	2,681	418
Buckie,	64,688	1,221	1,998
Findhorn,	23,381	207	747½
Cromarty,	1,272	...	46
Helmsdale,	3,083	45	70
Lybster,	6,255	48	191
Wick,	42,087	408	1,297
Orkney Isles,	305,804	9,665	43
Shetland Isles,	1,212,744	48,375	...
Stornoway,	524,768	19,787½	...
Loch Broom,	177,739	6,110	245
Loch Carron and Skye,	81,865	1,308	...
Fort William,	72,500	2,836	...
Campbeltown,	40,050	1,251	...
Total,	2,923,059	105,622½	5,907½

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE III.

COD AND LING FISHERY.—ACCOUNT, by Districts, of the Total Quantity of COD, LING and HAKE taken, both by Vessels and by Open Boats, at the Cod and Ling Fishery in SCOTLAND, and Cured, in the Year 1884; distinguishing the Fish Cured Dried and the Fish Cured in Pickle.

DISTRICTS.	Total Quantity of Cod, Ling and Hake Cured.		
	Number of Fish.	Cured Dried.	Cured in Pickle.
	<i>Number.</i>	<i>Cwts.</i>	<i>Barrels.</i>
Anstruther,	117,215	4,937	212
Montrose,	78,947	2,608	2
Stonehaven,	20,436	657	...
Aberdeen,	37,248	1,236	7
Peterhead,	31,346	601	540
Fraserburgh,	94,130	3,240	91
Banff,	77,769	2,681	418
Buckie,	64,688	1,221	1,998
Findhorn,	23,381	207	747½
Cromarty,	1,272	...	46
Helmsdale,	3,088	45	70
Lybster,	6,255	48	191
Wick,	42,087	408	1,297
Orkney Isles,	491,640	15,091	43
Shetland Isles,	1,668,788	60,129	...
Stornoway,	527,344	19,899½	...
Loch Broom,	177,789	6,110	245
Loch Carron and Skye,	31,865	1,303	...
Fort William,	72,500	2,836	...
Campbeltown,	40,050	1,251	...
Total,	3,607,828	124,506½	5,907½

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE IV.

COD AND LING FISHERY.—ACCOUNT of the Total Quantity of COD, LING and HAKE Exported from SCOTLAND, in the Year 1884; with the Districts from which Exported; distinguishing the Export to Ireland, to the Continent, and to places out of Europe; also whether Cured Dried or Cured in Pickle.

DISTRICTS.	Cod, Ling and Hake Exported.					
	To Ire-land.	To the Continent.		To Places out of Europe.	Total Exported.	
	Cured Dried.	Cured Dried.	Cured in Pickle.	Cured Dried.	Cured Dried.	Cured in Pickle.
	<i>Cwts.</i>	<i>Cwts.</i>	<i>Barrels.</i>	<i>Cwts.</i>	<i>Cwts.</i>	<i>Barrels.</i>
Leith,	10,806	3,930	...	2,124	16,860	...
Aberdeen, . . . . .	...	...	...	3,958	3,958	...
Orkney Isles,	2,163	1,960	...	1,200	5,323	...
Shetland Isles,	14,630	5,723	...	...	20,353	...
Stornoway,	4,227	...	...	...	4,227	...
Campbeltown,	1,145	...	...	...	1,145	...
Greenock,	2,155½	20	...	2,674½	4,850½	...
Total,	35,126½	11,633	...	9,956½	56,716½	...

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

APPENDIX B.—TABLE V.

COD AND LING FISHERY.—ABSTRACT, showing the Total Quantity of Cod, Ling, and HAKE Cured, Punched, or Branded, and Exported, year by year, in so far as brought under cognizance of Fishery Officers, from the 10th of October 1820, when the System for Encouragement and Improvement of the Cod and Ling Fishery commenced, to the 31st of December 1884.

PERIODS.	Total Quantity of Cod, Ling and Hake Cured.			Total Quantity of Cod Ling and Hake Punched or Branded.		Total Quantity of Cod, Ling and Hake Exported.	
	Cured Dried.		Cured in Pickle.	Cured Dried.		Cured Dried.	Cured in Pickle.
	Cwt.	Cwt.		Cwt.	Cwt. grs. lbs.		
Period extending from 10th Oct. 1820 to 5th April 1822,	...	...	Barrels.	Barrels.	Cwt.	...	Barrels.
Year ended 5th April 1823,	...	...	...	4,919½	19,578 3 "	...	...
Year ended 5th April 1824,	...	...	...	54,578	19,388 3 "	...	...
Year ended 5th April 1825,	...	...	...	63,590	23,068 "	...	...
Year ended 5th April 1826,	...	...	...	52,135	14,067 2 19	...	...
Year ended 5th April 1827,	69,136½	3,634½	5,621	66,315½	7,281 1 14	...	...
Year ended 5th April 1828,	95,161½	9,273	9,025	82,185½	14,061 2 27	...	...
Year ended 5th April 1829,	82,515½	6,796	6,142½	74,103½	18,208 2 "	...	...
Year ended 5th April 1830,	81,321½	5,786	6,819	73,500½	20,587 3 4	...	...
Year ended 5th April 1831,	101,914	5,652½	8,864½	92,314½	16,369 3 15	...	...
Year ended 5th April 1832,	27,674	...	2,860½	24,827½	11,920 1 1	...	...
Year ended 5th April 1833,	50,298	...	3,779½	13,879½	20,168 3 16	47	...
Year ended 5th April 1834,	58,461½	...	6,467½	13,681½	14,754 1 36	67	...
Year ended 5th April 1835,	52,710½	...	5,622½	14,254½	16,298 3 "	24	...
Year ended 5th April 1836,	44,153½	...	3,767½	9,492½	10,632 2 24	...	...
Year ended 5th April 1837,	38,040	...	2,276	6,766	10,992 2 30	...	...

APPENDIX B.—TABLE V.—Continued.

PERIODS.	Total Quantity of Cod, Ling and Hake Cured.			Total Quantity of Cod, Ling and Hake Punched or Branded.			Total Quantity of Cod, Ling and Hake Exported.		
	Cured Dried.		Cured in Pickle.		Cured Dried.		Cured Dried.		Cured in Pickle.
	Cwt.	Barrels.	Cwt.	Barrels.	Cwt.	Barrels.	Cwt.	Barrels.	Barrels.
Year ended 5th April 1837,	66,892½	7,373	...	...	9,589½	3,206	10,196	3 11	1½
Year ended 5th April 1838,	84,996½	10,303	...	...	9,259½	4,373	22,166	3 13	36
Year ended 5th April 1839,	85,279½	10,051½	...	...	23,936½	5,093	26,701	3 "	150
Year ended 5th April 1840,	93,560½	6,033	...	...	31,695½	3,205	39,656	1 "	24
Year ended 5th April 1841,	91,494½	9,480	...	...	31,029½	3,891	30,560	1 "	44
Year ended 5th April 1842,	76,849	7,083½	...	...	13,283½	2,164	23,293	1 "	...
Year ended 5th April 1843,	77,207½	6,431	...	...	10,060½	1,343	23,787	3 "	70
Year ended 5th April 1844,	92,813½	5,123	...	...	20,810½	2,226½	35,476	" "	4
Period extending from 5th April 1844 to 5th Jan. 1845,	83,919	1,726	...	...	17,940½	229	28,815	" "	20
Year ended 5th January 1846,	92,323	5,087	...	...	14,372½	935	29,352	" "	...
Year ended 5th January 1847,	90,753½	6,341½	...	...	12,387½	1,492	34,435	1 "	15
Year ended 5th January 1848,	86,624½	6,247½	...	...	8,145½	955	22,662	3 "	...
Year ended 5th January 1849,	85,463	6,810½	...	...	9,530	1,681	27,608	3 "	...
Year ended 5th January 1850,	98,903	6,588	...	...	15,556	997	34,154	1 "	20
*Year ended 5th January 1851, for Scotland and the Isle of Man only,	90,658½	5,082	...	...	†...	...	22,304	1 "	...
Year ended 5th January 1852, for do. do.	92,083½	7,019½	...	...	...	...	17,141	2 "	...
Year ended 31st December 1852, for do. do.	102,976½	6,886	...	...	...	...	18,994	2 "	...
Year ended 31st December 1853, for do. do.	105,596	6,123½	...	...	...	...	22,650	3 "	14

* The Collection of Returns for England ceased from the 5th of January 1850.

† The Punching and Branding of Cod and Ling ceased from the 6th of January 1850.

APPENDIX B.—TABLE V.—Continued.

PERIODS.	Total Quantity of Cod, Ling and Hake Cured.			Total Quantity of Cod, Ling and Hake Punched or Branded.			Total Quantity of Cod, Ling and Hake Exported.		
	Cured Dried.			Cured in Pickle.			Cured Dried.		
	Cwt.	Cwt.	Barrels.	Cwt.	Cwt.	Barrels.	Cwt.	grs.	lbs.
Year ended 31st December 1854, for Scotland and the Isle of Man only,	109,694½	...	6,166½	...	...	Barrels.	19,557	2	...
Year ended 31st December 1855, for do.	113,561½	...	6,316½	...	...	...	29,154	2	25
Year ended 31st December 1856, for do.	110,504½	...	6,442	...	...	...	29,629	3	...
Year ended 31st December 1857, for do.	104,668½	...	4,393½	...	...	...	24,310	...	...
Year ended 31st December 1858, for do.	91,896	...	4,584	...	...	...	22,152	...	...
Year ended 31st December 1859, for do.	118,323	...	5,262½	...	...	...	26,923	...	...
Year ended 31st December 1860, for do.	115,698	...	4,339½	...	...	...	32,221	...	...
Year ended 31st December 1861, for do.	85,344½	...	4,145½	...	...	...	26,961	...	...
Year ended 31st December 1862, for do.	100,657½	...	7,785½	...	...	...	32,969	3	...
Year ended 31st December 1863, for do.	126,724½	...	7,337	...	...	...	53,736	...	...
Year ended 31st December 1864, for do.	107,728½	...	7,963½	...	...	...	46,461	...	...
Year ended 31st December 1865, for do.	113,807	...	7,678	...	...	...	44,928	3	...
Year ended 31st December 1866, for do.	116,819	...	9,367½	...	...	...	47,753	...	15
Year ended 31st December 1867, for do.	119,638½	...	10,319	...	...	...	46,925	...	...
Year ended 31st December 1868, for do.	113,831	...	9,659	...	...	...	52,403	...	...
*Year ended 31st December 1869, for Scotland only,	135,586½	...	10,319	...	...	...	51,864	2	...
Year ended 31st December 1870, for do.	145,298½	...	9,945	...	...	...	56,400	2	...
Year ended 31st December 1871, for do.	179,030	...	9,283	...	...	...	54,171	1	...

* The Collection of Returns for the Isle of Man ceased from the 1st of January 1869.

APPENDIX B.—TABLE V.—Continued.

PERIODS.	Total Quantity of Cod, Ling and Hake Cured.		Total Quantity of Cod, Ling and Hake Pickled or Branded.		Total Quantity of Cod, Ling and Hake Exported.			
	Cured Dried.		Cured in Pickle.		Cured Dried.		Cured in Pickle.	
	Cwts.	Barrels.	Cwts.	Barrels.	Cwts.	grs. lbs.	Barrels.	
Year ended 31st December 1872, for Scotland only,	145,976½	11,940½	...	...	...	53,631 "	...
Year ended 31st December 1873, for do.	180,716½	12,381½	...	...	...	70,101 2	...
Year ended 31st December 1874, for do.	143,466½	6,754	...	...	...	60,913 "	...
Year ended 31st December 1875, for do.	187,788½	8,508½	...	...	...	81,890 2	...
Year ended 31st December 1876, for do.	111,457	6,109	...	...	...	59,886 "	...
Year ended 31st December 1877, for do.	187,200½	8,619½	...	...	...	73,368 2	...
Year ended 31st December 1878, for do.	183,809½	9,219	...	...	...	94,969 2	...
Year ended 31st December 1879, for do.	162,365	8,737	...	...	...	78,868 2	...
Year ended 31st December 1880, for do.	155,745½	7,794½	...	...	...	79,946 "	...
Year ended 31st December 1881, for do.	115,512½	4,075½	...	...	...	61,428 "	...
Year ended 31st December 1882, for do.	121,337	7,737	...	...	...	56,497 "	2
Year ended 31st December 1883, for do.	120,335½	7,310	...	...	...	56,525 2	...
Year ended 31st December 1884, for do.	124,506½	8,907½	...	...	...	56,716 1 "	...

N.B.—The Books of this department do not exhibit the Total Quantity of Cod, Ling and Hake Cured till the Year commencing 5th April 1895. The Bounty, from the commencement of this Abstract to the 5th April 1880, was 4s. per cwt. for Fish cured Dried, and 2s. 6d. per Barrel for Fish cured in Pickle, taken by the Crews of Vessels *not* on the Tonnage Bounty; while the Bounty for Vessels licensed for the Cod and Ling Fishery, on the Tonnage Bounty, was 50s. per Ton, for Tonnage and Cargo to the 5th of July 1826; 45s. from thence to the 5th of July 1837; 40s. to the 5th of July 1838, and 35s. to the 5th of April 1880, when the Bounties ceased altogether.

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

APPENDIX C.—(See separate Table hereto appended).

APPENDIX D.—TABLE I.

FISHERY STATISTICS.—Account of the Number of Boats, Decked and Un-decked, *irrespective* of the places to which they belong, employed in the Herring Fishery of SCOTLAND, in the Season of 1884, in a selected Week for each District; with the Number of Fishermen and Boys by whom manned; of Coopers, Gutters, Packers, and Labourers employed at the said Fishery in the Week so selected; and the Total Number of all such Fishermen and other persons so employed.

Districts where the Boats were employed at the Herring Fishery.	Boats.	Fishermen and Boys.	Coopers.	Gutters and Packers.	Labourers.	Total Persons Employed.
Eyemouth, . . .	434	2,449	181	1,431	418	4,479
Leith, . . .	120	480	45	150	44	719
Anstruther, . . .	239	1,484	73	350	90	1,947
Montrose, . . .	146	911	94	574	62	1,641
Stonehaven, . . .	102	663	51	315	51	1,080
Aberdeen, . . .	374	2,430	149	1,536	308	4,423
Peterhead, . . .	763	4,808	392	2,669	301	8,170
Fraserburgh, . . .	740	4,915	416	2,808	402	8,541
Banff, . . .	150	912	85	550	57	1,604
Buckie, . . .	114	674	41	330	25	1,070
Findhorn, . . .	66	392	17	198	20	627
Cromarty, . . .	24	140	6	72	6	224
Helmsdale, . . .	98	540	34	287	21	882
Lybster, . . .	119	660	41	274	26	1,001
Wick, . . .	543	3,529	276	2,002	210	6,017
Orkney Isles, . . .	290	1,984	102	896	45	3,027
Shetland Isles, . . .	932	5,577	403	3,274	87	9,341
Stornoway, . . .	1,167	6,778	323	2,755	173	10,029
Loch Broom, . . .	200	1,000	14	300	7	1,321
Loch Carron and Skye, . . .	385	1,275	58	422	87	1,837
Fort William, . . .	240	720	18	298	13	1,044
Campbeltown, . . .	428	1,284	19	30	...	1,333
Inveraray, . . .	284	1,092	5	35	59	1,191
Rothsay, . . .	140	420	7	51	19	497
Greenock, . . .	68	266	...	...	9	275
Ballantrae, . . .	443	1,772	68	129	192	2,161

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, *Secretary.*

ENDIX C.

h taken in SCOTLAND the Year ended 31st Dec. 1884,
 en in each District a

Halibut.		Sole.		Crabs.		Other kinds of Shell Fish.		Total Value of Shell Fish.	Gross Total Value.
Cwts.	Value.	Cwts.	Value.	Cwts.	Value.	Cwts.	Value.		
134	£ 385	26	£ 288	18,016	£ 11,020	1,888	£ 179	£ 12,771	£ 115,802
482	1,006	331	225	8,321	4,876	6,034	885	7,663	130,625
994	1,989	"	423	2,346	1,564	970	97	4,446	72,121
467	597	488	867	2,989	1,361	903	187	7,845	62,177
119	178	"	"	2,244	1,230	290	29	1,350	19,983
655	1,209	2,467	"	318	198	"	"	216	70,684
1,318	2,232	18	313	40	30	52	11	474	25,052
273	478	161	"	1,730	1,038	694	173	1,559	23,109
393	607	72	"	1,232	647	"	"	874	32,359
277	303	"	"	"	"	186	18	63	28,085
92	125	13	719	220	109	72	37	927	30,750
16	16	"	120	360	180	1,200	140	1,548	9,507
20	33	"	250	60	60	278	35	489	2,561
24	20	"	"	10	4	"	"	31	4,112
862	1,098	189	5	470	111	2,778	372	2,886	26,575
1,153	643	"	"	85	16	2,588	484	3,643	9,273
9,660	3,858	"	300	"	"	5,450	681	981	11,446
5,327	2,247	237	320	1,924	755	3,506	616	12,497	34,904
590	354	"	19	16	2	790	78	1,317	7,233
104	104	"	"	171	82	4,256	529	3,256	6,082
"	"	10	36	25	11	1,771	428	2,421	3,706
71	104	62	4	162	80	661	176	3,120	13,925
"	"	"	112	60	33	2,737	544	1,228	6,878
1	1	3	390	"	"	916	122	709	9,424
"	"	16	464	25	16	1,055	155	2,872	8,447
18	37	70	207	649	376	2,171	2,986	5,753	27,614
23,050	17,624	4,163	662	41,473	23,799	42,246	8,962	80,939	797,234

DUGALD GRAHAM, *Secretary.*

(p. 22.)

APPENDIX D.—TABLE II.

FISHERY STATISTICS.—ACCOUNT of the Number and Tonnage of Boats, Decked and Undecked, and Beam Trawl Vessels, employed in the Herring and other Sea Fisheries of SCOTLAND, in the year 1884, with the Districts to which they belong; the Number of Fishermen and Boys by whom manned; the Number of Fish-Curers, Coopers, and other Persons employed; with the estimated Value of Boats, Beam Trawl Vessels, Nets, and Lines.

DISTRICTS.	FISHING BOATS.										Value (Estimated) of—																	
	First Class 30 feet keel and upwards.		Second Class, from 18 to 30 feet keel.		Third Class, under 18 feet keel.		Beam Trawl Vessels.		Total.		Fish- men and Boys.		Fish- Curers.		Coopers.		Other Persons (Esti- mated).		Total Persons em- ployed.		Boats and Bm. Trawl Vessels.		Nets.		Lines.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
Eyemouth.	292	4,902	109	1,206	90	180	28	628	680	6,258	1,555	64	181	2,908	4,708	37,553	37,640	6,324	81,517									
Leith.	191	4,517	806	1,029	40	113	23	628	560	6,887	1,874	21	62	2,946	4,303	104,851	40,387	6,470	151,658									
Anstruther.	603	11,404	294	997	103	297	1	50	941	12,678	3,869	39	77	2,821	6,306	84,107	99,539	14,228	197,874									
Montrose.	219	3,771	212	839	218	268	5	190	684	5,068	1,402	17	94	1,784	3,247	63,435	28,134	8,915	100,484									
Stonehaven.	91	1,392	38	152	37	74	15	1,155	204	1,694	498	33	51	606	1,153	10,355	10,390	2,875	23,520									
Aberdeen.	190	1,920	125	756	87	160	...	...	298	3,905	987	43	149	3,686	4,865	52,235	16,808	3,590	72,653							
Peterhead.	318	6,995	179	978	80	294	1	23	578	7,230	1,840	86	394	3,895	6,215	56,079	45,685	6,004	105,768									
Fraserburgh.	369	7,011	66	516	278	894	...	...	733	8,361	2,261	78	416	4,160	7,005	50,485	60,325	7,181	118,091							
Banch.	292	4,430	50	300	201	603	...	...	533	6,338	1,611	35	86	1,082	2,814	21,949	23,110	4,500	49,658							
Buckle.	672	12,096	41	203	188	414	1	82	479	6,602	2,376	28	68	3,198	7,265	112,790	107,560	17,177	237,457									
Findhorn.	345	6,970	107	574	29	58	...	...	307	2,586	970	7	18	1,341	5,011	45,183	46,316	4,940	96,439							
Cromarty.	130	1,966	112	484	65	133	...	...	219	2,087	790	19	38	407	1,252	11,200	24,680	2,600	38,480							
Helmsdale.	175	2,760	13	67	32	84	...	...	207	2,861	1,095	12	41	330	1,478	10,184	13,426	1,395	22,639							
Lysabur.	175	2,760	13	67	32	84	...	...	207	2,861	1,095	12	41	330	1,478	10,184	13,426	1,395	22,639							
Wick.	435	7,692	64	372	356	763	...	...	845	8,727	3,011	78	276	3,759	7,124	59,516	49,428	925	25,831							
Orkney Isles.	171	2,638	26	203	434	958	...	...	633	3,779	2,920	87	102	1,225	3,884	17,296	11,840	1,928	30,564							
Shetland Isles.	332	4,690	121	242	224	324	...	...	677	5,156	3,106	38	409	3,999	7,562	41,832	27,984	4,555	74,371							
Sornoway.	207	3,185	373	2,601	591	1,773	...	...	1,171	7,569	4,165	40	73	2,892	8,170	36,046	26,564	8,780	70,390							
Loch Carron and Skye.	88	1,345	52	358	600	1,887	...	...	785	3,490	2,346	38	14	1,046	3,444	9,294	16,245	2,282	27,321							
Fort William.	36	612	256	1,054	658	1,324	...	...	950	2,991	2,904	75	53	574	3,606	6,232	25,972	3,236	35,440							
Campbeltown.	79	1,327	431	1,004	480	1,004	...	...	630	1,875	1,254	48	18	687	2,002	4,488	8,556	8,840	8,864							
Inveraray.	81	1,560	426	2,433	179	358	4	60	693	3,875	1,792	42	24	589	2,447	23,535	18,440	1,010	42,985									
Rothesay.	27	405	216	1,075	128	283	...	...	684	3,437	1,467	37	7	375	1,886	15,243	16,591	1,676	32,510							
Greenock.	4	53	178	724	113	113	...	...	371	1,766	675	22	7	292	996	9,509	10,149	44	19,702							
Ballaunare.	8	99	268	1,079	829	377	...	...	806	1,988	489	23	40	908	1,480	4,564	4,955	661	10,080							
Total.	5,392	92,595	4,278	21,787	5,724	12,909	61	2,284	15,445	129,575	49,860	1,061	2,809	48,832	102,563	902,197	783,539	117,100	1,802,886									

Fishery Board for Scotland.
Edinburgh, 1st May 1885.

DUGALD GRAHAM Secretary.

APPENDIX D.—TABLE III.

FISHERY STATISTICS.—ACCOUNT of the Tonnage of Shipping, and of the Number of Seamen engaged in the Trade of the Herring and Cod and Ling Fisheries of SCOTLAND, in the year 1884; distinguishing those employed in Importing Stave Wood, Hoops, and Salt; in Carrying Herrings or Cod Fish coastwise; or Exporting them abroad; and distinguishing British from Foreign Tonnage and Men.

DISTRICTS.	TONNAGE AND MEN.													
	Importing Stave Wood and Hoops for the Fisheries.				Importing Salt for the Fisheries.				Carrying Herrings or Cod Fish Coastwise.				Exporting Herrings or Cod Fish.	
	British.		Foreign.		British.		Foreign.		British.		Foreign.		British.	
	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.	Tons.	Men.
Eymouth,	103	7	172	10	1,264	72	66	4	1,219	100	1,418	116	1,927	235
Leth,	160	6	235	20	264	20	...	...	780	38	...	481	0,318	7,522
Anstruther,	393	92	1,226	81	208	17	...	...	...	...	...	...	...	7,522
Montrose,	150	10	236	12	1,095	44	...	...	308	17	1,707	72	1,705	615
Stonhaven, . . . . .	...	...	...	...	582	97	...	...	...	...	...	...	...	1,943
Aberdeen,	9,730	591	971	12	2,040	121	...	...	1,238	79	8,978	248	8,978	3,208
Peterhead,	1,227	80	5,792	322	6,980	265	792	30	280	36	6,672	335	6,672	1,043
Fraserburgh,	1,348	25	2,029	126	5,990	333	582	28	246	24	3,686	493	3,686	2,154
Ballintrae, . . . . .	...	...	...	...	1,487	88	...	...	236	50	1,175	10	2,146	1,018
Buckle,	20	2	...	...	702	18	...	...	62	16	...	...	...	8,978
Findhorn, . . . . .	...	...	...	...	225	13	...	...	...	...	...	...	...	261
Tomary,	140	18	441	24	341	32	...	...	...	...	...	...	...	66
Remdale,	88	5	188	4	472	32	...	...	60	4	...	...	...	4
Lycester,	73	13	...	...	501	32	...	...	...	...	...	...	...	13
Orkney Isles,	2,192	182	3,106	210	6,080	436	96	6	919	86	4,538	388	5,673	43
Shetland Isles, . . . . .	...	...	87	8	8,450	287	218	11	1,185	77	266	18	4,177	25
Stornoway,	530	24	456	27	13,974	781	...	...	6,900	340	9,832	491	10,812	1,037
Loch Broom,	30	10	120	7	4,468	308	260	13	7,222	618	318	678	6,409	258
Loch Carron and Skye, . . . . .	...	...	...	...	709	63	...	...	1,000	106	...	...	...	491
Fort William, . . . . .	...	...	...	...	2,450	124	...	...	2,116	131	...	...	...	31
Campbeltown, . . . . .	...	...	...	...	790	69	...	...	1,350	100	...	...	...	1,773
Inveraray, . . . . .	...	...	...	...	287	25	...	...	1,990	116	...	...	...	4,639
Rothsay, . . . . .	...	...	...	...	195	9	...	...	5,287	320	...	...	...	2,140
Greenock, . . . . .	...	...	...	...	250	18	...	...	1,969	82	...	...	...	6,602
Ballintrae,	90	6	...	...	1,558	69	...	...	1,117	57	...	...	...	2,185
Total,	15,302	962	16,072	902	88,228	3,406	2,294	108	82,926	2,313	57,451	2,832	69,964	10,833
Fishery Board for Scotland, Edinburgh, 1st May 1885.														74,817

DUGALD GRAHAM, Secretary.

APPENDIX D.—TABLE IV.

FISHERY STATISTICS.—ABSTRACT ACCOUNTS, showing the Tonnage of Vessels and Number of Men, the Tonnage of Boats and Number of Fishermen and Boys, and the Number of other Persons employed in the Herring, Cod and Ling, and other Sea Fisheries of SCOTLAND, in the Year 1884.

ABSTRACT.	Tonnage of Vessels and Number of Men.				Tonnage of Boats, and Number of Fishermen and Boys.		Number of other Persons.	Total Tonnage and Persons Employed.			
	British.		Foreign.		Tons.	Fishermen and Boys.		British.		Tons.	Persons.
	Tons.	Men.	Tons.	Men.				Tons.	Persons.		
Total of Herring Fishery Account, Appendix A—Table I., . . .	3,685½	574	...	...	...	...	...	3,685½	574	...	...
Total of Cod and Ling Fishery Account, Appendix B—Table I., . . .	3,235	667	...	...	...	...	...	3,235	667	...	...
Total of Fishery Statistics Account, Appendix D—Table II., . . .	...	...	...	...	129,575	49,860	52,703	129,575	102,563 103,804	...	...
Total of Fishery Statistics Account, Appendix D—Table III., . . .	179,419	10,533	74,817	3,739	...	...	...	179,419	10,533	74,817	3,739
Total,	186,339½	11,774	74,817	3,739	129,575	49,860	52,703	315,914½	114,337	74,817	3,739

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

APPENDIX D.—TABLE V.

FISHERY STATISTICS.—ACCOUNT of the Number of Lives lost in connection with the Sea Fisheries of Scotland; the Number of Boats totally wrecked, and Value thereof; the Number of Boats damaged, and Amount of Damage; and the Loss on Nets and other Fishing Material lost or damaged, in the Year 1884.

DISTRICTS.	Lives Lost.	Boats totally Wrecked, and Value thereof.		Boats Damaged, and Amount of Damage.		Gross Loss on Boats totally Wrecked or Damaged.	Loss on Nets and other Fishing Material Lost or Damaged.	Gross Total Loss on Boats, Nets, &c., Lost or Damaged.
		Number.	£	Number.	£			
Eyemouth,	4	3	245	1	6	251	2,370	2,621
Leith,	3	1	1,600	4	250	1,850	1,185	3,035
Anstruther,	3	4	340	1	15	355	595	950
Montrose,	1	...	...	10	50	50	1,150	1,200
Stonehaven,	1	...	...	1	2	2	83	85
Aberdeen,	3	...	...	2	15	15	2,430	2,445
Peterhead,	4	2	260	2	60	320	310	630
Fraserburgh,	2	...	...	3	88	38	742	780
Banff,	...	...	...	4	120	120	1,020	1,140
Buckie,	4	1	250	4	128	378	1,144	1,522
Findhorn,	1	2	550	6	200	750	947	1,697
Cromarty,	...	...	...	2	10	10	43	53
Helmisdale,	5	...	...	3	57	57	134	191
Lybeter,	...	...	...	...	...	...	31	31
Wick,	1	1	70	10	305	375	6,495	6,870
Orkney Isles,	6	1	6	4	127	133	1,683	1,816
Shetland Isles,	5	1	200	3	60	260	600	860
Stornoway,	3	4	56	10	195	251	150	401
Loch Broom,	9	2	240	2	70	310	140	450
Loch Carron and Skye,	7	6	245	8	85	330	750	1,080
Fort William,	1	3	40	9	48	88	484	572
Campbeltown,	5	...	...	...	...	...	104	104
Inveraray,	1	...	...	...	...	...	36	36
Rothsay,	4	2	45	1	18	63	200	263
Greenock,	...	...	...	7	36	36	188	224
Ballantrae,	...	6	180	15	120	300	150	450
TOTAL,	73	39	£4,327	112	£2,015	£6,342	£23,164	£29,506

Fishery Board for Scotland,
Edinburgh, 1st May 1884.

DUGALD GRAHAM, Secretary.

APPENDIX E.—No. I.

Dr. HARBOUR AND TELEGRAPHIC EXTENSION ACCOUNTS.—ACCOUNT of the Receipt, *ex* Herring Brand Fees, and Expenditure by the Fishery Board for Scotland, for Building or Repairing Piers or Harbours, and for Telegraphic Extension to Remote Fishery Districts. Cr.

1883.	December 31.	To Balance at this date,	£5300	0	0
		<i>Bank Interest.</i>			
1884.	July 31.	To Bank Interest on this Account at Exchequer year to 31st March 1884,	30	0	0
			<hr/>		
			£5,330	0	0
			<hr/>		
			£5,330	0	0

1884.	<i>Re-transference to Grant for Piers or Quays, &c. (Herring Brand Fees).</i>
March	31. By Re-transferred to Eb. Grant for Piers or Quays, &c. (Herring Brand Fees), to provide, along with savings on other subheads of the vote for Fishery Board for Scotland, for expenses incurred by the Scientific Investigation Committee of the Board in the prosecution of scientific investigations, .
	£168 1 4

	<i>Transference to Piers or Quays Deposit Account (5 Geo. IV. cap 64).</i>
August	1. By Transferred to Piers or Quays Deposit Account (5 Geo. IV. cap. 64), as per Appendix E. No. II.,
	5,161 13 8
	<hr/>
	£5,330 0 0

Fishery Board for Scotland,
Edinburgh, 1st May 1885.

DUGALD GRAHAM, Secretary.

Re-transferrence to Grant for Piers or Quays, &c. (Herring Brand Fees).

March 31. By *Re-transferrence to Ex. Grant for Piers or Quays, &c. (Herring Brand Fees),* to provide, along with savings on other subheads of the vote for Fishery Board for Scotland, for expenses incurred by the Scientific Investigation Committee of the Board in the prosecution of scientific investigations, . . . £168 1 4

Transferrence to Piers or Quays Deposit Account (5 Geo. IV. cap 64).

August 1. By Transferred to Piers or Quays Deposit Account (5 Geo. IV. cap. 64), as per Appendix E. No. II., . . . 5,161 13 8

£5,330 0 0

<i>Ness Harbour, Island of Lewis.</i>	
" " Payments for the harbour works at Ness during the year ended this date, viz. :-	£2,291 4 9
Works,	100 0 0
Engineers' fees,	
	<u>2,391 4 9</u>
<i>Crovie Landing Slip, Banffshire.</i>	
" " Payments for the works at Crovie during the year ended this date, viz. :-	
Works,	£615 0 0
Engineers' fees,	12 12 0
Inspector's wages,	108 18 6
Miscellaneous,	7 8 0
	<u>743 18 6</u>
<i>St Monance Harbour, Fife-shire.</i>	
" " Payments for the harbour works at St Monance during the year ended this date, viz. :-	
Works,	1,804 10 0
	<u>1,804 10 0</u>
1884. TOTAL EXPENDITURE,	£10,113 17 6
December 31. " Balance at this date,	419 8 0
	<u>£10,563 5 6</u>

DUGALD GRAHAM, Secretary.

Fishery Board for Scotland.
Edinburgh, 1st May 1885.

APPENDIX E.—No. III.

REPORT by the ENGINEERS upon the State of the HARBOUR WORKS in progress under the FISHERY BOARD FOR SCOTLAND in the Year 1884.

We have now the honour to submit to the Board the following Report on the works in progress during the year 1884 :—

Findochty Harbour, Banffshire.—The works at Findochty, which were contracted for by Messrs Brand & Son, Glasgow, were finished in the beginning of November. The harbour consists of a western pier, extending for a length of 540 feet, and an eastern pier of 200 feet in length, with an entrance of 65 feet in width between them. These piers enclose an area of nearly $4\frac{1}{2}$ acres. The interior of the harbour to the extent of about $1\frac{1}{2}$ acre has been deepened to the level of low water spring tides, the remainder being sloped up towards the high water line. Two patches of rock which impeded the fairway have also been removed. The construction of this harbour affords complete protection to the boats, and will otherwise be a great boon to the fishermen of the district, enabling them to leave for the fishing grounds at a much earlier period of the tide than was formerly the case, and on returning they will also have earlier access and sheltered accommodation at the commodious quays on which to discharge their fish.

Crovie Landing Slip, Banffshire.—The works for providing a small landing slip for the fishing creek at Crovie were begun in April last, and were suspended for the season in December. The works will be resumed as soon as the state of the sea and weather will admit.

Stonehaven Harbour, Kincardineshire.—The Board having authorised a marine survey to be made of the Bay of Stonehaven, with the view of a design and estimate for extending the harbour being made out, we had the survey made, and two designs were submitted with our Report of 3rd September last, the smaller estimated to cost £24,000, and the larger £67,000.

The smaller design consists of a short breakwater, about 420 feet long, extending into a depth of 5 feet at low water of ordinary spring tides; also a short breakwater of about 250 feet in length, projecting from the angle of the outer pier of the present south harbour of Stonehaven, and ending in about $2\frac{1}{2}$ feet of water at low water spring tides. These breakwaters would shelter a space of about $1\frac{1}{2}$ acre, having a depth varying from 2 to 4 feet at low water ordinary springs, while alongside the outer breakwater there would be a depth of from 2 to 5 feet at low water spring tides, and these latter depths could be increased by dredging, so that boats would be able to land their fish at the outer breakwater at low water springs. This design also provides for the deepening of the basin of the south harbour to low water springs, and for other alterations on the existing works; it is on the smallest scale which can with advantage be adopted at Stonehaven.

We also submitted an enlarged design, consisting of (1) a north break-

water about 800 feet in length, terminating in 14 feet at low water ordinary spring tides; (2) a south breakwater 380 feet in length, and terminating in a depth of 14 feet at low water; (3) the removal of rocks in the angle betwixt the proposed north breakwater and the outer kant of old north pier to the level of low water; (4) the removal of the parapet of the present north pier, and the construction of a new quay on the seaward side, at which boats could discharge; (5) the widening of the road at north side of harbour; and (6) the deepening of the south harbour, as in the smaller design.

This design, if it could be carried out, would take much fuller advantage of the most valuable part of the bay for a boat refuge harbour than the smaller design. It would shelter an area of about $2\frac{6}{10}$ acres, having depths of from 6 to 14 feet at low water, and would embrace altogether an area to low water mark of $7\frac{1}{2}$ acres, exclusive of the present harbours. If this more extended harbour cannot be carried out at present, no design intermediate between it and the smaller design should be encouraged; for any work situated between the two would irremediably and permanently injure both harbours as well as the bay itself.

St Monance Harbour, Fifeshire.—The works for the improvement of the entrance to the harbour of St Monance, which consisted of widening, deepening, and sheltering the entrance channel, were carried out by days' wages under an Inspector of Works, and were completed in December last.

Ness Harbour, Island of Lewis.—The works connected with the formation of a small fishing harbour at Ness, near to the northern extremity of the Island of Lewis, have been conducted during last season by days' wages, under an Inspector of Works, and they are now rapidly drawing towards completion. The harbour is found to afford complete shelter to the boats occupying it, and the entrance is found to be easily taken. Being erected on a sandy coast, there will, as at all such harbours, be occasional accumulations of sand, which will require removal from time to time.

Broadford, Skye.—An inspection and preliminary report and estimate were made in relation to a fishery pier for the Broadford district, Skye.

D. & T. STEVENSON.

EDINBURGH, 6th March 1885.

APPENDIX F.—No. I.

ON THE DEVELOPMENT OF THE HERRING. PART I

By GEORGE BROOK, F.L.S.

INTRODUCTION.

In giving an account of the development of the herring, I propose first of all to give a *resumé* of what is already known on the subject, and afterwards to give an account of my own investigations. This seems the more necessary as Kupffer's papers on the subject, although well known to embryologists, have, so far as I am aware, not been translated in England. In this part I have taken Kupffer's paper, 'Ueber die Entwicklung des Herings im Ei,' *seriatim* chapter by chapter, and have added from time to time such notes from his other papers and from those of other authors as seemed necessary. I have not, however, referred to such of the more recent results in this department of embryology, as although necessary for a proper comprehension of the subject, they do not bear specially upon Kupffer's work.

It has appeared necessary to reproduce some of Kupffer's figures in this part, but the task has been a difficult one. The majority in the original paper are reproductions of photographs, and although useful in their way are difficult to copy on account of want of definition over the greater portion of them. It has been my endeavour, however, to make these drawings agree with Kupffer's descriptions, and details have only been added from original drawings when they appeared to be in harmony with Kupffer's views. Throughout I have endeavoured to express only the opinions of others, or at any rate to refer only to the past, reserving a discussion of the subject from my own standpoint for future papers. The following is a list of the papers referred to:—

- C. Kupffer, 'Zur Entwicklung d. Knochenfische,' *Archiv Mikros. Anat.*, Bd. iv.
- C. Kupffer, 'Z. Entw. des Herings im Ei,' *Jahresb. Comm. deutschen Meere* for 1874-76 (Berlin, 1878).
- C. Kupffer, 'U. Laichen u. Entw. des Herings,' *Jahresb. Comm. deutschen Meere* for 1874-76 (Berlin, 1878).
- Axel Boeck, *Om Silden og Sildefiskerierne*, &c., Christiania, 1871.
- H. A. Meyer, 'Beob. u. Wachthums d. Herings,' *Jahresb. Comm. deut. Meere* for 1874-76 (Berlin, 1878).
- C. K. Hoffmann, *Zur Ontogenie d. Knochenfische*, Amsterdam, 1881.
- C. v. Noorden, 'D. Entw. d. Labyrinthes b. Knochenfische,' *Arch. Anat. u. Phys.*, Anat. Abth. 3, x.
- J. T. Cunningham, 'On the Significance of Kupffer's Vesicle in the Herring,' *Quar. Jour. Micros. Science*, January 1885.
- F. M. Balfour, *Comparative Embryology*, vol. ii. 1883.
- J. A. Ryder, 'Embryog. of Osseous Fishes,' *Report U.S. Fish Comm. for* 1882, Washington, 1884.
- Agassiz and Whitman, 'On the Development of some Pelagic Fish Eggs' (prelim. account), *Proc. Amer. Acad.*, vol. xx. 1884.
- G. Brook, 'On the Origin of the Hypoblast in Pelagic Teleostean Ova,' *Quart. Jour. Micros. Science*, January 1885.

I. Ripe Egg and Milt.

The ripe egg in water has almost a globular form. It sinks to the bottom in sea water with 2-3 per cent. of salt in it, if it does not strike

any object in falling. If eggs are emptied into water in a mass they adhere together just as they were placed there, in clusters. This adhesiveness is not characteristic of herring eggs only; it is found in many fish eggs, and has already been described by Von Baer in various Cyprinoids. The size of the egg (as observed in the spring herring of the Schlei, in the autumn herring of the Great Belt, and in herring from Pillau in East Prussia) is from .92 to 1 mm. in diameter. A few eggs are smaller than this, some even only .85 mm. The egg of the North Sea herring of the Norwegian coast is, according to Boeck, considerably larger than this; he gives the diameter before the egg has increased by inception of water as 1.5 mm. The egg is composed of the following parts—(1) Egg membrane, (2) a viscous substance which envelopes the egg surface, (3) the yolk.

The egg membrane, according to Boeck, is tough and elastic, and when torn appears to be composed of several layers. It is not perforated by pores or canals, but an optical section of the periphery shows a fine radial striation. The skin, which closely invests the yolk, consists of two layers closely connected with each other—an inner one finely striated radially, and an outer through which the fine striation is not continued, but which, however, appears concentrically striated. The inner layer observed from the concave surface shows, thickly set, fine dots, which correspond to the radiate striations. Kupffer was at first inclined to attribute this phenomenon to radial pore canals, but adds that it must be distinctly understood that they are not continued through the outer lamellose layer, and therefore cannot open externally. The outer concentrically striate layer cannot be split from the inner one, and must not be confused with the more outward layer of adhesive matter. Very dilute hydrochloric acid caused a swelling up of all three layers, and each is then distinctly separated from the others. The thickness of the double layered membrane is somewhat variable. In the egg of the autumn herring of the Great Belt it is from .006 to .008 mm. thick, and somewhat thinner in the Pillau herring. The thickness also varies during development. At first, under the influence of water inception, it increases a little; from the third day onwards there is a constant thinning, which chiefly takes place at the cost of the porous inner layer. Sometimes the surface appears faintly faceted; this, however, soon disappears.

The viscous substance which causes the eggs to adhere to one another is developed evenly around the egg as it leaves the ripe female, as can easily be seen by dropping the egg directly into spirit. Put into water the substance behaves differently, according to the form of the surface adhered to. On a smooth horizontal surface it sinks to the lower pole, and in the form of a plate cements the egg to the surface. Eggs that come in contact with each other link themselves together by bridge-like strands. If an egg in sinking touches any object an attachment mostly follows, and the adhesive substance is thereby drawn out into a short strand. This substance quickly hardens in water, and the strand-like portions assume a fibrous structure. The thin layer which remains enveloping the unattached portion of the egg remains homogeneous and transparent.

The porous inner layer of the herring corresponds to the entire egg-membrane of most fishes, according to Kupffer, the outer layer being not so generally distributed. These two layers are known as the zona radiata and the vitelline membrane. The outer layer in the egg membrane of the herring may be compared with the second layer in the pike, as described by Reichert and by Aubert, through which also the pores of the inner layer are not continued. Kölliker and Eimer both speak of a second egg membrane in Teleosteans, and both state they have found this structural rela-

tion wide spread. Eimer attributes a different origin to the two layers, considering the inner as a cuticular formation of the egg-cell itself, and the outer as a product of the follicular epithelium. Kupffer is of opinion that the different structure of the two layers in the herring supports this theory.

The micropyle is difficult to see, according to Boeck. He states that it consists of a saucer-shaped impression in the egg membrane with a uniformly rounded floor, the angles of impression proceeding with a gradual curve into the rest of the egg surface. The central portion of the floor forms a thickened boss, the centre of which is pierced by a very fine opening which leads into a funnel-shaped canal widening inwards. After fertilisation numerous spermatozoa may be seen clustering round the micropyle. Some seek to penetrate with their head-shaped part into this opening while the tail is kept in rapid motion, and after some time appear to be completely dissolved without having penetrated the funnel-shaped opening. After fertilisation Boeck was unable to discover a spermatozoon or part of one inside the egg membrane, and concluded that the micropyle was closed by a transparent cuticle, and therefore that fertilisation takes place by an endosmotic inception of the dissolved seminal bodies. Kupffer's account differs considerably. He found no boss-like projection and no funnel-shaped opening on the inner surface. He doubts whether the micropyle plays any part in the fertilisation of the egg of the herring. According to him, the micropyle is not constant in shape. The hollow on the outer surface is often filled up by the viscous covering of the egg before it has become hard.

The yolk fills the entire unfertilised egg. Boeck says the whole interior of the shell is filled with pale transparent yolk bodies of a vesicular appearance. These are more or less elongated, egg-shaped, or more rounded, of somewhat different size, and contain no nuclei. Immediately under the egg membrane is a layer of round, strongly refractive globules of an oily nature, which often run together into large drops and cover the yolk bodies, so that these cannot always be distinctly seen. Boeck has also been unable to discover a germinal vesicle in the ripe unfertilised ovum. Kupffer divides the yolk into three parts. The superficial layer consisting of strongly refractive shining homogeneous globules, $\cdot 008$ to $\cdot 02$ mm. in diameter, he terms *yolk granules* (Dotter körner). The chief part of the yolk, the less refractive drop-like bodies, he terms *yolk globules* (Dotter kugeln). These measure from $\cdot 05$ to $\cdot 08$ mm., and some even smaller. Besides these two there is a scanty viscous mass of protoplasm mixed up with them. In the unfertilised egg there is no germinal vesicle, nor that fine granular layer of yellowish protoplasm which later forms the blastodisc, nor is there any collection of fat in any particular spot.

The ripe milt is a thickish viscous milk-white substance of alkaline reaction which incompletely separates in fresh water. On the other hand, this separation is rapid and complete in sea water. The spermatozoa show a head, tail, and middle portion, and are similar to those figured by His for the salmon. They are not flattened, however, but round and thimble-shaped. The surface is formed of a shining refractive substance, while the axial portion is clear, and scarcely more refractile than water. The pale, weakly, refractile tail is joined to the head by a middle portion which bears a small transverse disc. Length of the head, $0\cdot 0025$ mm.; breadth, $0\cdot 0020$ mm. Length of the tail, $0\cdot 062$ to $0\cdot 075$ mm.

Since Kupffer's investigations Hoffmann has made a careful examination of the egg of the Zuiderzee herring, particularly in its early stages. There is only one race of herring in the Zuiderzee. The spawning usually takes place in April, but may be a little earlier or later according as there is a

mild or severe winter. The mean saltness of the water, as observed by Hoffmann, was 74370. At a mean temperature of 9°·4 C. the embryos hatch out on the twelfth day, the newly-hatched young measuring 6·2–6·4 mm. The newly-hatched embryo of the Baltic herring, according to Kupffer, is 5·2 mm. long; and that of the North Sea herring, as observed by Boeck, 10 mm. It should be noted, however, in this comparison that there was considerable difference in the temperature of the water, and the time occupied by the development within the egg as compared with Hoffmann's observations. Hoffmann made a minute examination of the egg capsule, both in the ripe egg and also before it reaches maturity.

In the nearly ripe egg the zona radiata consists of two layers, closely united together, which could not be separated. The whole thickness is 0·0325 mm., which is made up as follows:—outer layer, 0·010 mm.; inner layer, 0·0225 mm. The outer layer is perforated by very fine pore canals, and a sharp line separates it from the inner layer. The latter is also perforated by pore canals, which are finer than in the outer portion; but Hoffmann was unable to decide whether the two sets of canals communicate one with the other. The inner layer is not uniform in structure, but is itself divided into two sections. The outer one is more or less concentrically striated, the pore canals forming with these a rectangular network. The line separating this from the inner portion is variable in thickness, and sometimes was not observed. The structure of the egg membrane in ripe eggs, which are placed directly in $\frac{1}{10}$ per cent. osmic acid, is considerably different. The pore canals in the outer layer are not easily seen, but have not yet entirely disappeared. This portion now contains a large number of small globules, and the whole membrane has the appearance of one connected layer. If the ripe eggs are, however, first brought in contact with sea water and afterwards placed in osmic acid, transverse sections give quite another appearance. The outer layer is quite separated from the inner one, and partly lays in folds, and constitutes the viscous substance which serves for the attachment of the egg. The thickness is 0·010–0·012 mm.; this portion also now often shows a laminated structure, which was not observed in the earlier stages. The outer portion of the inner layer shows strong concentric striations, or often parallel lamellæ. The pore canals are no longer visible, probably being obscured by the concentric markings; thickness, 0·010 mm. The inner portion shows no change, and is 0·012 mm. thick. Hoffmann concludes that there is only one egg membrane in the herring, which he terms the *zona radiata*, and maintains that Kupffer's statement that there are two rests on insufficient observation, he not having been acquainted with the changes which this membrane undergoes immediately before the eggs are laid, and also when acted upon by sea water.

As to the origin of the zona radiata, Hoffmann remarks that the peripheral layers of the zona are more distinct than the inner ones, and that this distinctness gradually diminishes towards the yolk. It would thus appear as if new layers were continually added from the inside, and thus the zona radiata would be a true vitelline membrane—a secretion from the yolk.

Hoffman has never seen a second egg-membrane inside the zona radiata, and very much doubts if one exists. Should there be one, it would of course represent the true vitelline membrane, and in this case the zona radiata would be regarded as a secretion of the follicular epithelium (*Granulosa zellen*).

In transverse sections of the hardened egg, it sometimes appeared as if the yolk was surrounded by only one pellicle, being bounded by a sharp line. This was often the case when the sections were incomplete or were

broken in consequence of uneven contraction during the hardening process. Hoffmann is, however, inclined to regard this line as caused by the hardening reagent.

With regard to the egg contents, Hoffmann adopts Kupffer's terms, *Dotter kugeln* and *Dotter körner*, for the two sizes of yolk spheres. The unripe egg contains a large number of the large yolk spheres 0·035 mm. in diameter, and very little protoplasm. In the ripe egg there are fewer of the large yolk spheres. Some of these are more homogeneous, others are filled with smaller spheres 0·002 mm. in diameter. These small ones are seen lying in heaps outside the larger spheres, and appear to be set free by the rupture of the walls of the latter. The germinal protoplasm has no constant position in the ripe unfertilised egg. It may be diffused generally through the yolk mass or collected in patches on the surface; there is usually, however, a considerable aggregation around the micropyle.

II. Formation of the Blastoderm and Fertilisation.

(a) *Influence of the Sperm in the formation of the Blastoderm.*—Kupffer concludes from observation and from repeated experiments—

1. That the egg of the herring shows at the moment when it reaches the water from the oviduct no trace of a germinal disc, or indeed any separation into formative and nutritive yolk.
2. The structure described in the previous section is maintained in water from which any chance of impregnation has been excluded. Water *per se* alters nothing in the relations of the yolk, nor of the egg-shell with the yolk. No water enters through the egg membrane, nor does the latter separate from the yolk at all. He tried also the influence of fresh water and of weakly saline water (·3 to ·4 per cent.). In either the eggs might remain for twenty-four hours without any perceptible change.
3. If, however, the salt water is previously supplied with milt, or if the milt is added some time after the eggs have been laid, in about fifteen minutes the egg membrane separates from the yolk, and a clear space appears between the two; water penetrates through the shell, the yolk globules decrease in size, and there now begins in the yolk a complicated series of phenomena, ending in the separation into formative and nutritive yolk, and finally the concentration of the former at one pole as the germinal mound. [I purposely use the word mound here in preference to disc, because the *whole of the protoplasm* does not collect at the germinal pole until the end of the segmentation stage, so that part does not enter into the formation of the disc proper. Indeed, as we shall see later, Kupffer supports Klein's theory of Archiblast and Parablast].
4. Eggs and milt were added to the fresh water of the Haff, but no change took place in the eggs; they behaved as if in unfertilised water.
5. The spermatozoa penetrate in *great numbers* through the egg membrane. They are easily seen in the breathing chamber (*Eiraum*) after this is established. Kupffer also expressly states that the spermatozoa penetrate *on all sides* into the yolk.

Thus Kupffer concludes that in the egg of the herring the blastodisc is formed under the combined influence of sea water and sperm. He admits that this must be a striking exception, as the majority of authors agree that in *fresh-water fishes* the sperm is not necessary for the separation of germinal substance and nutritive yolk, Coste appearing to be the only

one who regards the disc as resulting from fertilisation alone. Hoffmann combats Kupffer's view that the germinal layer is formed under the combined influence of the milt and sea water, and maintains that in the herring, as in other teleosts, the germinal layer exists before fertilisation.

Boeck's observations agree with those of Kupffer, excepting that he states that, *whether the egg is fertilised* or not, a portion of the yolk rises up, takes a yellowish colour, and segments. Kupffer thinks this statement founded on error, and that Boeck's eggs must have been accidentally fertilised, or that the different specific gravity of the water was the cause (Boeck worked with sea water containing 3 per cent. of salts, that used by Kupffer only containing 0.3 to 0.4 per cent.). Kupffer also suggests that very saline water may so alter the viscous layer as to make it permeable to water, and cites an experiment of Ransome with the eggs of the stickleback. The details of Kupffer's experiments are as follows:—

- 1st series.—Eggs were immediately fertilised in salt water of 0.3 to 0.4 per cent. salt contents, and at 16° C. The breathing chamber began in from 12 to 20 minutes from time of fertilisation (30 experiments).
- 2d series.—Ripe eggs alone were placed in water of same composition, but taken at a considerable distance from place of capture of fish. The eggs adhered quickly, and as firmly as the fertilised ones, but *showed no trace of the phenomena resulting* from fertilisation. Six experiments after 20, 30, 45 minutes, 2 hours, and twice after 24 hours, there was no change.
- 3d series.—Milt was added to eggs which had been a variable time in salt water without showing any change. The whole of the eggs within at the outside 20 minutes showed the formation of the breathing cavity (4 experiments):—
 1. Eggs that had been in sea water 20 minutes had milt added to them. The breathing chamber began to form in 13 minutes, and was distinctly present in all after 20 minutes, with separation of formative from nutritive yolk.
 2. Eggs that had remained unfertilised in sea water for 40 minutes showed the same phenomena after milt was added.
 3. Similar experiment two hours after the eggs were laid gave the same result.
 4. Eggs that had remained unfertilised in water for 24 hours were influenced in the same way by addition of milt.

Effect of Fresh Water.—Two experiments; water taken from the Haff. No change was brought about in the eggs by the addition of milt. Concludes that the composition of the water must be the cause, but that further experiments are needed.

(b) *Course pursued in the formation of the Blastoderm.*—Water penetrates through the egg-shell, and apparently not only in the region of the micropyle, but equally all round. This causes a stretching of the egg-shell, which becomes uniformly globular, and the egg increases in volume. This increase does not correspond to the entire breadth of the breathing chamber, as the yolk contracts at the same time, as may be proved by direct measurement. The following are two instances given by Kupffer:—(1) A globular egg of the Pillau herring measured 0.92 mm. in diameter before commencement of the water space. After inception of water the diameter increased in 45 minutes to 1.2 mm. The yolk mass now deviates

somewhat from the globular form, and has for its greatest diameter 0·85 mm., and in the direction at right angles to this 0·82 mm. (2) Egg measured originally 1·0 mm., and after formation of breathing chamber 1·29 mm. The yolk and disc measured 0·97 mm. by 0·92 mm. Other measurements lay between these two extremes. The shrinking of the yolk in connection with the formation of the breathing chamber does not appear to be clearly stated by Balfour in his *Comparative Embryology*. During this occurrence a small quantity of yolk is dissolved in the fluid of the water chamber. This fluid is not pure water, but shows on addition of nitric acid a fine granular coagulation, as Reichert has also shown. Whether the diminution of the yolk may be ascribed to this cause alone, or whether there is also an active contraction of the yolk or a passive condensation, Kupffer is unable to decide.

After the water space has begun to form, and the changes on the surface of the yolk may be followed more clearly, the first change is the disappearance of the yolk granules (Dotter körner). Kupffer ascribes this disappearance to their being dissolved. With their disappearance the yolk spheres become more visible, as if a part of the small globular structures which they enclose had dissolved. The next appearance is remarkable. *Clear vacuoles* arise at the surface of the yolk between the yolk spheres. They are to be distinctly recognised as water clear spots; they increase rapidly in size, become elongate, extend inwards, and then flow together into a network, and go through the whole yolk as a coarse set of tubes. With the appearance of the clear vacuoles the yolk substance begins to separate into two parts—the formative yolk and the nutritive yolk. This is the first appearance of the formative yolk, and it shows as a narrow marginal layer, uneven in thickness. A close examination shows that the *formative yolk appears as a continuous superficial layer*. It undergoes frequent fluctuations, but finally collects at one pole. Often there is a temporary large collection at the pole opposite where the disc will ultimately form, which may easily be mistaken for the real germinal area. Kupffer calls this the *gegenhügel*, and it may often be seen after the disc has begun segmentation (in the four-cell stage, or even later). From the disc proper the remaining formative yolk, which envelops the nutritive yolk, is distinguished as the *cortical protoplasm* (rindenprotoplasma). The blastoderm rests on the yolk as the segment of a sphere with a flat base. During the separation of the formative yolk the structure of the nutritive yolk has again changed. The system of communicating tubes arising from the vacuoles on the surface, and in a manner draining the whole yolk, disappear from the surface altogether, and there remains only in the interior one or a pair of large lacunæ, often continued towards the flat base of the germinal area by a stalk. These central hollows vary in number and extension, but are constantly to be seen till the end of development,—now as two contiguous large vacuoles, which may unite with each other,—now as a large flask-shaped structure, with the neck reaching to the base of the segmenting disc. These have much in common with the *latebra* of the hen's egg. They are not to be considered as distinct cavities, but as transition areas in which the globular yolk masses are transformed into a more clear and uniform mass. The whole series of phenomena above described, from the first beginning of the water chamber to the complete formation of the germinal disc, is very rapid in the herring's egg. Ryder is of opinion that the lacunæ described by Kupffer do not normally exist in the herring egg, but are produced by the hardening reagents used. According to him they are not to be regarded as *latebra*, in the sense of the structure of that name found in the ovum of birds.

The formative yolk, on its first appearance, was clear and homogeneous.

It soon, however, becomes granular and yellowish in colour, in consequence of larger and smaller particles of food-yolk being mixed up in its substance. The formative yolk thus grows at the expense of the nutritive yolk; and just before the first segmentation furrow, the former occupies about one-fifth of the whole yolk mass.

(c) *Impregnation of the Egg by the Spermatozoa*.—Kupffer, unlike other observers, has seen a large number of spermatozoa in the breathing chamber of the herring egg. He argues that the micropyle cannot be an open channel, as no water enters in the unfertilised egg. It cannot, therefore, be the point of entry of the sperma; indeed, it is constantly turned upwards, and the upper pole is very often covered. The eggs fall and adhere to one another in cakes and clumps 1 cm. thick, and yet can all be fertilised even when the milt is added after the complete hardening of the viscous layer. Again, the egg capsule does not separate first at one point, but uniformly all round. Kupffer states that it is a fact that the spermatozoa penetrate the egg in great numbers, but has not actually seen them penetrating the egg. The spermatozoa in the water space gradually diminish towards the ninth hour: none could be found ten hours after fertilisation. Between the fifth and ninth hours, however, none could be observed to penetrate the yolk; they pushed against the cortical layer, but seemed to meet with an obstacle, probably the altered form of the surface. Their disappearance can only be considered as a dissolving in the fluid of the water chamber. These observations, Kupffer says, agree with those of Hensen on the rabbit; and in this case also the spermatozoa appear to live for a long time in the fluid bathing the yolk.

(d) *Fertilisation*.—Arranging the phenomena, Kupffer gives the following table:—

Appearance of first spermatozoa in yolk	after 3 minutes.
Formation of water chamber begins	" 15 "
Appearance of first vacuole on surface	" 18 "
Appearance of cortical layer	" 25 "
Definite going over of protoplasm to one-half of the egg	" 45 "
Completion of concentration into blastodisc, and appearance of first furrow	" 120 "

He regards the sperm as being necessary to the formation of the disc, so that the conception of the word must be enlarged. Besides the act of fertilisation, it has the auxiliary effect of rendering the eggs permeable to water. The succeeding phenomena up to the complete concentration of the germinal layer could be ascribed to the influence of water alone, since these phenomena occur in the eggs of other species from which the milt has been excluded.

III. Segmentation.

The completed disc is flat at the base, and has a peripheral extension of 130°. The yolk contains the lacunæ already described. V. Bambeke describes similar structures, and is inclined to regard them as pseudopodia of the blastoderm. Kupffer dissents entirely from this view, regarding them as fused masses of yolk-spheres, which serve to supply the germinal layer with material both during the formation of the latter and during the early segmentation stages. Indeed there are always more large yolk particles collected at the base of the germinal layer than in any other part of it, and this portion also is more transparent and not so granular as the upper portion.

The first furrow commences one and a half to two hours after fertilisa-

tion as a short linear depression at the vertex of the germ. The margins of the depression rise up at first as knob-like mounds, and then extend with the elongation of the furrow into rounded pads. Apparently also a furrow begins at the base, and a portion of the yolk presses keel-like upwards, but this phenomenon has no further progress; and as the upper furrow deepens, the base of the germ again becomes flat—sometimes, indeed, somewhat convex. During the formation of the first furrow, a thinning of the protoplasm in the cortical layer occurs; so that in the most active stage the mound appears to have disappeared from the opposite pole. When, however, the furrow has reached the basal layer, and there is a pause in the process, the cortical layer streams back again, and forms a mound at the opposite pole, as before. These phenomena are further accompanied by changes in the shape of the egg, from an approximately globular form into a more elongate shape. The germinal axis lengthens at the expense of the equatorial: this elongation lessens with the progress of the furrow, and at the conclusion of the process has again disappeared.

The next phase is not a second meridional furrow, but *the constricting off of both the segment spheres at their bases*—consequently an equatorial furrow which divides the germ from the cortical layer. Hoffmann maintains that an equatorial furrow is the first to take place, but this is again denied by Agassiz, Whitman, and other investigators. The whole subject will be entered into more fully in the second part of this paper.

Segmentation then goes on in the upper portion only, the cortical layer under the disc remaining passive, and merely fluctuating from one pole to the other. The *second meridional furrow* crossing the first at right angles commences about half an hour later. It is preceded by both segmentation spheres rising up steeply and becoming almost conical. The cross furrow appears in the two summits simultaneously, and as it progresses, the segmenting spheres again sink down to their normal position, sometimes even they appear to sink a little into the yolk. Kupffer, however, admits that his observations at this stage may not be quite accurate, as the increased temperature at which the early stages were studied brought about certain abnormalities.

The following two furrows arise parallel to the last, and divide the germ into eight segments. Regularity in the direction of the furrows now ceases, and large and small segments are found.

The blastodisc broadens out, and seen from above has an elongate elliptical form, the longer axis corresponding to the direction of the first furrow. Only towards the end of the process, 11 or 12 hours after fertilisation, does the outline become more regular, and the segmentation spheres more equal in size. About the 15th or 16th hour, segmentation has ceased. The cells of which the disc is made up measure from 0.015–0.016 mm. The volume of unsegmented yolk is to the segmented blastodisc as 2 : 3.

The first nuclei were observed in the sixteen cell stage. They have a clear centre, surrounded by a circular arrangement of fine granules. Clearly defined spherical hyaline nuclei were not observed until a much later stage. Similar nuclei were observed later in the cortical layer at the time of cell formation.

A hyaline or at least only slightly granular cortical layer of clear protoplasm so clearly shown by His in the salmon egg, and also in other fishes, was not observed by Kupffer in the herring; yet it appears probable that such a layer does exist, thinly covering the yolk, although not of sufficient thickness to show as a distinct layer. His observes, that after injury to

the surface, the inner protoplasm flows out in pseudopodia-like masses, and this has also been observed by Kupffer.

The various phenomena accompanying cell division in the disc are clearly brought out at abnormally high temperatures, and occur in the following order :—

1. The cell preparing to divide elevates itself in the direction of the future division plane.
2. Next the first trace of a furrow appears as a slight depression at the vertex. This soon changes into a linear depression with tumid edges.
3. The furrow extends over the surface, and sinks inwards.
4. Next wavy folds (Faltenkranz) arise on both sides of the furrow. This is more noticeable at a high temperature.
5. Next the axis of the double resulting cell shortens.
6. Then the mass sinks somewhat into the yolk.
7. Rises again suddenly before the division is fully complete.

I reproduce Kupffer's figures of this process (fig. 12), and append his description of them, as a study of these points will be entered into more fully in a later paper.

A, shows extension of cell in a radial direction.

B, is taken 15 minutes later, and shows commencement of furrow and the collection of the cortical layer lying upon the yolk in a strong protuberance under the dividing cell.

C, is taken 15 minutes later again, and shows wavy folds of inner furrow on each side. The base is still undivided. The protuberance of the cortical layer is less.

D, 25 minutes later than C. Division complete, the two new cells now no longer sink in the yolk mass, but lie on the surface.

The whole of the above process occupied about an hour at 9° C.—a temperature corresponding to that of the spawning bed.

IV. Cell Formation in the Cortical Protoplasm (Parablast).

About ten hours after fertilisation a process of cell formation analogous to 'free cell formation' begins in the cortical layer (parablast), and this goes on until the germinal disc begins to extend over the yolk. About the sixteenth hour, there is a uniform pavement of cells. Near the margin of the disc these are thicker, and partly also several layers deep; further towards the equator they become quite flat. Thus a wall of parablast cells surrounds the disc. As these cells are formed, the cortical protoplasm collects around the disc, forming there as a thick rim, and there is also a thinner stratum pushed under it. From this time onwards, the fluctuations in the cortical protoplasm cease, and the thickness becomes so reduced at the opposite pole as to be scarcely observable. With the strongly refractive yolk for a background, small globular transparent spots may be observed in the parablast at regular distances from each other. Careful observations show that *these portions of clear protoplasm arise from dot-like beginnings, and grow to a size of 5-6 μ .* They are therefore large near to the disc, and smaller further away. Around these clear globular nuclei the protoplasm so arranges itself, that next to each nucleus there is a fine granular mass, and further away there are coarser granules. Cells are thus formed whose limits are first marked off by the coarser granules, and afterwards by a linear contour. This network of cells is scarcely complete when the cells nearest the disc begin to divide, the result being that now the nuclei nearest the disc are smaller than those further away. The changes in connection with this cell division are not easily seen in the

living egg, and are more easily recognised by their effects. It is also impossible to tell from direct observation whether the same process goes on *under* the disc. As Kupffer's photographs do not show this layer distinctly, he gives two drawings from sections of the egg, which are here reproduced. Fig. 13 is from an egg twelve hours after fertilisation, and shows between the disc (Archiblast), which is uniformly composed of roundish cells, and the yolk, a layer distinct from the former, thin towards the centre, and showing a thick wall under the margin of the disc. Within the yolk is a hollow, a latebra filled with a clear substance, which narrows off to a neck under the centre of the disc, so that the clear contents are intimately connected with the subgerminal layer. The two, however, are distinct, as the latter is finely granular in texture. In this layer nuclei are to be seen, more distinctly in the thickened portion, but also throughout the whole extension under the disc. The peripheral portion shows separation into cells, but the cell outlines are not clear. These cells in the parablast are quite distinct from those in the disc, being undefined in outline and granular; while the latter are sharply limited, uniformly rounded in outline, and strongly refractive. The germinal disc is bounded on its upper surface by a single flattened layer of cells already differentiated as the epidermal layer of the epiblast (Deckschicht). The nuclei of the cells in the disc are also smaller than those in the underlying layer, the latter throughout showing the same appearance as they do in a surface view of the living egg.

The free cell formation commences in the thickened portion of the periblast, and extends both under the yolk and peripherally around it. Whether cells already formed are pushed under the disc from the thickened rim was not determined, but, according to Kupffer, this can only be regarded as possible. Indeed, under the disc itself, nuclei are always to be observed before the cells themselves, so that these would appear to be formed *in situ*.

Fig. 14 is taken from a section of an egg eighteen hours after fertilisation, and after the disc has begun to extend over the yolk. The cells of the disc are more subdivided than in the previous figure, and the epidermal layer is more clearly defined. Beneath the disc is a continuous layer of flat spindle-shaped cells, and the same structure is seen in the thickened welt under the margin. The difference between the size and shape of the cells in the two layers is now very marked. Thus at the time the disc begins to extend over the yolk, there lies between them a *continuous deep layer* constituting the parablast. Kupffer remarks that the only difference in V. Bambeke's observations of *Leuciscus rutilus* is, that in the latter, the periblast ends with the peripheral welt, while in the herring the parablast extends over the surface of the yolk to beyond the equator of the egg.

V. *Resumé.*

The fifth section of Kupffer's paper is mainly given up to a summary of the conclusions already arrived at, which need not be reproduced here. There are, however, one or two paragraphs which appear worth summarising.

First Segmentation Nucleus.—Kupffer was unable to observe the first segmentation nucleus in the egg of the herring, but gives the following account of the appearance of this structure in the egg of the pike. Quite at the base of the germinal protoplasm, amongst a multitude of small oil-globules, the nucleus appears as a transparent, homogeneous globule, which gradually increases in size. It is ultimately bounded by what appears to be a nuclear membrane. No nucleolus was observed. It seems strange

that a nucleus should arise so deep in the germinal protoplasm, and in a layer which does not take part in the segmentation process. If it remained there it would not be possible to deduce the nuclei of the first two segmentation spheres from it. As a matter of fact, however, it arises quite out of this area as the increase of the bulk of the germinal protoplasm goes on. Kupffer has seen this nucleus divide, and the first furrow go down between the two newly-formed nuclei. He thinks it possible also that a similar process takes place in the egg of the herring.

Archiblast and Parablast.—Kupffer considers that his observations tend to support His's theory of *Hauptdotter* and *Nebendotter*—not, however, as originally promulgated. He maintains that the embryo is not exclusively formed from the cell material which has arisen from segmentation of the germinal disc, but that cells also take part in this process which have arisen by free cell formation in the cortical protoplasm, and independently of the disc altogether.

Later authors are not at all agreed upon this point. Hoffmann admits the origin of the parablast which is described by Kupffer, but denies that this layer takes any part in the formation of the *tissues* of the embryo—that, in fact, it does not help to build up the hypoblast. Agassiz and Whitman, again, deny altogether the *independent origin* of the parablast, stating that it arises by segmentation from the *margin* of the disc. They also deny that the parablast takes part in the formation of the hypoblast.

In a recent paper of my own I have seen reason to agree more nearly with Kupffer's view from a study of the eggs of *Trachinus* and *Motella*.

This question is, however, too lengthy to enter into here, and I propose to defer any remarks of my own (as indeed I have done throughout) to future papers.

VI. Extension of the Archiblast and Formation of the Germinal Layers.

About the 17th hour the cell mass of the archiblast begins to extend. The cells of the parablast have at this time reached the equator, and as the archiblast spreads over them, and a view of the peripheral belt can no longer be obtained in the living egg. How long it remains Kupffer is unable to say, but concludes (though not with certainty), from an examination of sections, that both layers grow on together, and that the peripheral welt is then lost. As the extension takes place the middle thins out, and the margin becomes distinctly thicker. According to several authors, the segmentation cavity is formed at this period, but Kupffer has been unable to observe it in the herring, although very prominent in other fishes. A cavity may, however, easily be formed by suddenly cooling the water in which the eggs are developing. Contraction then takes place in the thickened portion of the archiblast, and in consequence the thinner central portion leaves the yolk, and a cavity is thus formed. After a time, however, the strong contraction ceases, the central portion gradually sinks to its normal position, and the cavity is again obliterated. It is interesting to note that this contraction does not prove injurious to the development of the embryo. It shows, however, that at this stage a close union does not exist between the two layers. Hoffmann, on the other hand, affirms that he has proved the existence of a segmentation cavity in the herring as in other fishes, from a study of sections of the egg.

After the marginal rim has arisen, it splits up into two layers (about the twenty-second hour). The under layer, becoming continuous at its free margin with the upper one, is at first only very thin, and stops sharply at the germinal pole. Consequently the fissure which separates the two

layers is short. There is thus added to the other two layers—the archiblast and parablast—a third and median one, which at first and for a long time remains less developed than the others. It merely appears as a ring zone, and is quite absent under the central thin region of the archiblast. *These three layers represent the three germinal layers of bony fishes—epiblast, mesoblast, and hypoblast.* The two former arise out of the archiblast, and the latter is the transformed parablast. As already stated, however, Kupffer's views on this point have not received much support during the last few years. He is, however, very confident about the significance of the parablast, as the following extract will show:—‘The formation of a layer lying on the yolk by free cell formation in the protoplasm of the parablast is a fact, and no conclusion based on probability. The question can only be whether it is to be considered as entoderm, as Darmdrüsenblatt, or whether it is a new one altogether—a structure so far not seen in any egg, a cell-layer of quite transitory existence between the hypoblast and the yolk. . . . I consider that the deep layer formed from the parablast is entoderm.’ Kupffer also supports Cellacher in combating Götte's view that his secondary layer is due to an invagination. ‘An ein faktisches Umklappen des Randwulsts ist nicht zu denken.’ He, however, admits that the supposition was only natural, and that there does *appear* to be an invagination when only surface views of the egg are examined.

VII. Foundation and Development of the Embryo.

Since the researches of Lereboullet it has been generally agreed that, in the teleostean ovum, the embryo is built up from the marginal rim already described by a meridional lengthening of that body, but later investigators differ considerably in their account of the details of the process. Kupffer, in a paper on ‘The Development of Teleostean Fishes’ (*Archiv f. Mikros Anat.*, Bd. iv. p. 221), has thus described the process:—‘The extension of the disc over the yolk is quite centrifugal, the germinal pole remaining as the central point of the hood-like blastoderm. During this process a separation takes place between the middle and margin of the blastoderm in a double sense—(1) a separation of the cell mass, and (2) a difference in the form of the cells in the two regions. The middle thins out, and the middle thickens uniformly all round. Simultaneously the cells in the two regions become different. Those in the middle portion flatten and become transparent, and are united together in the form of a polygonal pavement epithelium. The cells of the margin remain rounded, and preserve a certain freedom of motion; they are of small diameter, and constantly increase by division. After the blastodermic rim is formed a change takes place. Hitherto the movement of the cell mass has been equal in all directions. In the second phase the movement takes place only in an equatorial direction, the consequence being that the rim becomes thinner on one side and thicker on the other. The one-sided thickening thus formed forms the first foundation of the embryo. This now grows out towards the germ pole as an arched lamina—the embryonal shield. The first foundation of the embryo takes place at quite different stages in the development of the blastoderm around the yolk, in different species of fishes. In *Gasterosteus* this occurs before the rim has reached the equator, in *Gobius* not until it has enveloped the whole yolk. Thus, in the latter, the embryo arises in that part of the egg turned away from the germinal pole.’ Kupffer remarks that this account is incomplete in one respect,—the formation of the mesoblast from the rim. This was not clear when he wrote as above, but Götte's work has since added greatly to our

knowledge. He still, however, holds, after further investigation, that the opinions he then expressed are in the main correct, and is still more inclined to adhere to them than to accept the alternative views of Cellacher and His. The eggs of the trout and salmon, with which they worked, are not so suitable for studying these points. The processes referred to are much shortened; indeed, the extension of the disc, the formation of the rim, and the foundation of the embryo, take place simultaneously in these forms. Cellacher says that the edge of the rim, where the thickened embryonal foundation occurs, remains fixed, and that the envelopment takes place by the progress of the thinner half; so that the close of the process takes place at a spot which, from the beginning, contained the thickening. Götte confirms this, and speaks of the original dissimilarity of the two halves of the rim in the trout, but does not consider the thickened portion remains fixed. His does not completely accept Cellacher's view, but regards the head end (Kopftheil) of the thickened rim as a fixed point. Kupffer combats this view, but it is possible he has not clearly understood His's point. By photographic and other methods he has convinced himself that in both the herring and stickleback the spreading out of the disc is equal in all directions until it passes the equator of the egg.

The closure of the blastoderm around the yolk is completed about the 33d hour, and the embryo then occupies half the circumference of the egg. The head end extends somewhat beyond the germinal pole and runs out to a point, and the caudal end projects as a round knob which corresponds with the earlier marginal thickening of the rim. This knob provides material not only for the caudal extremity but also for a large part of the posterior portion of the trunk, including a considerable part of the mesenteron. The closure of the blastopore is effected in the following manner:—The embryonal side of the crater-like opening is higher than that opposite to it. A yolk plug is then pressed into this opening, and the caudal end, growing forwards, closes the aperture. The closure is here terminal, while in the stickleback it is dorsal. Kupffer, however, attaches little importance to the position of this closure.

At this time the fore and hind parts of the embryo become distinct, the former is considerably thicker and shows two prominences. The anterior of these corresponds to the later fore and mid brain, the other to the boundary between the brain and spinal cord. At the same time a keel presses deeply into the yolk from the ventral side, but does not extend to the posterior third of the embryo. A shallow dorsal furrow is formed on the surface, but, as in other teleostean fishes, does not extend the whole length of the embryo. Calberla, however, says that in *Sygnathus acus* the furrow extends from head to tail; but this is exceptional. The hind end remains constantly convex in the herring. The furrow has only a temporary existence, and does not close in, as is the case in Batrachians, Birds, and Mammals, to form the central canal. Kupffer does not consider it homologous, therefore, with the medullary groove of higher animals. The furrow appears in the herring when the embryo fills an arc of 180°, and reaches its maximum development about the tenth proto-vertebra from the head. About the 36th hour the embryo has increased in length, so that it occupies 270° of the circumference. The head end is markedly thickened and raised up from the yolk. Instead of the simple terminal brain lobe there are now two prominences, the anterior representing the primitive fore brain, from which arise laterally the eye lobes; the posterior corresponding with the mid brain, but as yet not limited posteriorly. The next portion, the neck prominence, belongs no longer to the brain, but is constricted off towards the chorda. Seen from above, however, no other division is shown except the limitation of the fore brain,

which is very marked. In the fore brain there is a middle cylindrical cord, and two lateral eye lobes. Kupffer maintains that, contrary to Götte's researches, the eye lobes are the immediate product of the fore brain, and not of the so-called sensory plate. The protovertebræ begin to divide about the 30th hour, and at the stage above described there are already ten. At the beginning of the third day, the embryo spans an arc of 300° to 330° , and there are twenty protovertebræ. The separation of the eye lobes from the brain, and the invagination of the otocysts and eye-lenses, begin almost simultaneously. The two latter appear at first as shallow, approximately circular discs, over which the epiblast extends as a double layer of cells; the upper, *epidermal layer* (Deckschicht), has the cells flattened, while those in the *nervous layer* are cubical. Van Noorden has since given a detailed account of this process. The epidermal layer has now become raised up from the whole surface of the embryo, and only in the head of the embryo, at the points of formation of the otocyst, lens, and nasal pit, is there any connection with the lower nervous layer. These three areas are afterwards isolated as special formative centres. In the formation of the epidermis there is a marked difference between the trout on the one hand, and the herring and stickleback on the other. Cellacher expressly says that a simple layer of the nervous portion of the epiblast (the sensory plate) is continued over the whole yolk at the close of the process of envelopment, and the epidermis is therefore here two-layered.

The central nervous system begins to get hollow between the 50th and 55th hours. Without exception the lumen first arises in the eye stalks, then a narrow fissure appears in the eye lobes themselves, then in the primitive brain divisions. The lumen in each then gradually extends until all flow together.

Kupffer's vesicle arises when the dorsal furrow has reached its maximum development, and appears as a shallow prominence covered by the marginal rim. It is most prominent during the 3d day, and lies almost outside the embryo, pressing against the yolk. A simple wall of cylindrical epithelium encloses it. This vesicle contains a clear fluid in which there is no concretion such as is found in the stickleback and pike. The cylindrical cells of the wall are distinctly nucleated. The significance of this vesicle has long been a disputed point, and in the herring Kupffer was unable clearly to make out its origin or to trace its final fate. He, however, regards it as analagous with the epithelial sac of the allantois in higher vertebrates. Cellacher thinks Kupffer has confused this vesicle with the blind sac of the post-anal gut. Kupffer, however, denies this, and says that the formation of the latter is easily followed, and begins where the trunk of the embryo begins as a *free growth* over the yolk sac. Cunningham, in a recent paper on this subject, is inclined to regard Kupffer's vesicle as a remnant of the larger cavity resulting from invagination in other forms. Kupffer lost sight of the vesicle bearing his name before the blind sac of the post-anal gut appeared in the embryo of the herring, and could not therefore follow its transition into the urinary vesicle which later is seen distinctly behind the anal gut. He therefore concludes that his former view was not correct, and asks, 'Can it be a primordial secretory organ, 'which disappears after the primitive excretory ducts are formed?'

Heart.—Kupffer is not inclined to accept Cellacher's statement as to the origin of the heart itself, although he agrees thoroughly with his account of the formation of the pericardial cavity. From a study of the egg of the pike, herring, and stickleback, Kupffer concludes that the heart is formed in these fishes quite in accordance with Hensen's observations on the rabbit. The heart arises as a thickened invagination from the

pericardial plate on each side. The heart begins to pulsate slowly on the 4th day. At this time it lies quite medially, but is bent, the convexity being downwards.

Brain.—After the eye lobes are constricted off, and the invagination of the solid lens has begun, the constriction between the mid and hind brain becomes more marked. The two parts broaden towards their point of union, and at the same time the roof of the hind brain thins out into a transparent triangular plate, broad anteriorly. The part of the hind brain immediately in contact with the mid brain takes no part in this process, but remains as a thickened fillet, the cerebellum. The development of the brain is throughout analogous with that of birds and mammals.

The embryo begins to move on the 4th day. The intestine extends blindly into the hind end of the trunk, and its epithelium consists of palisade cells. The lumen is so narrow that no yolk elements can enter, as is the case in Cyprinoids. There is no direct continuation into the caudal plate, and therefore no connection between this and the notochord, as suggested by Götte.

Notochord.—Kupffer does not attempt to explain the *origin* of the notochord. Originally it consists of roundish polygonal cells of which there are three or four in cross section, but these soon flatten and become wedge shaped. On the 4th day transverse rows of at first dot-like strongly refractive granules make their appearance, which become confluent, and form refractive discs between the cells. When the process is completed the notochord consists of a simple series of hyaline segments, which Kupffer terms secondary chorda cells. The individual hyaline cylindrical segments each contain a globular nucleus, which is always excentrically situated, and this again encloses a nucleolus which shows amoeboid movements. Over the whole there stretches a thin homogeneous sheath in which no nuclei could be found.

On the 5th day the hind gut is brought into communication with the exterior. The epithelium at the blind end of the gut sends down a solid plug, and a similar one grows inwards from the epidermis until both meet. They then fuse together, a lumen then arises by divergence of the cells which extends both upwards and downwards. The development within the egg is essentially completed on the 6th day, and on the 7th when the young hatch out there is little change excepting a slight increase in length.

VIII. *The newly-hatched Embryo.*

The following particulars of the newly hatched embryo are taken from Kupffer's paper "Ueber Laichen und Entwicklung des Herings":—

Total length,	. . . . .	5.2-5.3 mm.
From anterior end of head to yolk,	. . . . .	0.8 "
Length of yolk,	. . . . .	1.0 "
From hind end of yolk to anus,	. . . . .	2.5 "
From anus to end of tail (including fin),	. . . . .	1.0 "
Greatest breadth of head,	. . . . .	0.75-0.8 "
Body narrows suddenly immediately behind the prominent otocysts, and is there	. . . . .	0.35 "
Height of body (including both fins) just behind yolk,	. . . . .	0.7 "
In this the two fins have a share of	. . . . .	0.3 "

The whole body is colourless and quite transparent, with the exception of the eyes, whose pigment is uniformly black. On each side of the trunk there is a row of jagged pigment cells. The primordial fin begins at a point corresponding with the limit between the brain and spinal cord, and extends continuously round the tail to the hind end of the yolk. The fin

is the broadest on the tail, and shows there most distinctly the fine needle-shaped primordial rays. The pectorals are in this stage the only other fins present. The whole epidermis consists throughout of a single layer of flat cells. In the anterior region, these cells contain, besides the nucleus, a large number of refractive round granules; these granules are entirely absent in the posterior region. The cells of the epidermis are excitable and contractile in a high degree, as also are the epidermal cells of the primordial fins. The only skeleton is the chorda dorsalis, and there is no trace of cartilage. The mouth is open, even gaping. An upper and under lip, and two lateral margins can be distinguished, but the lips show no movement. The communication of the mouth with the intestine arises about this time. Some embryos are hatched with the channel open, in others the connection is made after hatching. There are four gill slits already present, and a fifth is forming. The arches between these do not contain any cartilage, but the cells already show an arrangement which precedes its formation. The intestine is a uniform tube without any communication with the yolk. Its epithelium shows ciliary action in its whole length. A cylindrical blind sac branches off about 1 mm. in front of the anus. It is probably the foundation of the liver. There is no trace of a swimming bladder. The urinary system consists only of the two primitive excretory ducts. The circulatory system is very incomplete. The heart is a simple tube which opens on the surface of the yolk. Towards the head it is continued into a short vessel, out of which proceed two or three pairs of aortic arches, embracing the gullet. Other vessels are not to be seen. The heart pulsates powerfully, and circulates a clear serum devoid of any solid particles, and there is no trace anywhere of blood corpuscles.

In three or four days the young embryos reached a length of 7.5 mm., and in the majority the yolk was then absorbed. In a few individuals of 8 mm. length, there was, however, a thin strand of yolk behind the heart. During the first three or four days after hatching new structures arise,—the first piece of the cartilaginous skeleton. A plate belonging to the base of the skull is then formed, and the cartilaginous rods of the gill arches arise almost simultaneously. A little later a globular body appears under the chorda in the interior part of the trunk, which Kupffer regards as the foundation of the glomerulus of the kidney.

At a length of 7.5 mm. the under jaw begins to move, but is then not able to close the mouth. A distinct swallowing movement was observed in the œsophagus, by which water reaches the intestine, and is then moved along by ciliary action.

After the yolk is wholly consumed, growth still continues for a few days without taking food. Conical projections arise on the anterior side of the gill arches—the foundation of the teeth. There is no trace, however, of the gill lamellæ. The clavicle appears as a slender shining arch, which comes in contact with that of the other side in the ventral middle line. The cartilaginous pieces of the shoulder girdle are still completely absent. The under jaw now extends a little in front of the upper one. Previously the reverse was the case. In the upper jaw the cartilaginous formation begins in conjunction with the cartilaginous plate of the base of the skull, which is already present. All these relations are found in embryos from 9–10 mm., of which Kupffer kept some till the tenth day. At that time the mouth could not be closed, and there was still no trace of blood corpuscles.

Thus the young herring in its early stages grows and adds new structures to its organisation, *without blood and without a special respiratory organ*. Kupffer believes that respiration is chiefly effected by the ciliary action of the intestine, which causes a gentle but constant stream of water

to pass through the alimentary tract. The lively swimming movement of the young fish may also help to bring about an exchange of gases.

IX. Biological Observations made during the Artificial Raising of Herrings in the Western Baltic.

Some of the results arrived at in Meyer's paper bearing the above title were mentioned in the Board's last report; but the paper is of such practical value that I propose here to give a more detailed account of Meyer's experiments. The fish from which the eggs were obtained were caught near Bappeln, on the Schlei, on the 26th of April. The temperature of the water at the time was $47^{\circ}12$ Fahr., and the specific gravity 1.0076. The following experiments were made:—

1. A number of eggs were placed in the open water of the Bay of Kiel. Temperature $51^{\circ}8$ to $53^{\circ}6$ Fahr., and specific gravity near the surface 1.0106.

The young fish hatched in from ten to eleven days.

2. The eggs in this experiment were likewise hatched in the Bay of Kiel; but from the 2nd to the 5th day they were kept in water whose temperature was only $35^{\circ}6$ Fahr., in order to learn (a) the influence of cold water on eggs in an early stage of development, and (b) the result of suddenly placing them in cold water.

The hatching was retarded four to five days, but the eggs were not injured in the least by the sudden change of temperature.

3. Eggs which for eight days had been in water at $51^{\circ}8$ to $53^{\circ}6$ Fahr., and whose development had almost been completed, were suddenly placed in water at $35^{\circ}6$ Fahr.

The eggs were not injured, but hatching was very much delayed. If the eggs had been left in the water at $51^{\circ}8$ to $53^{\circ}6$ Fahr., they would have hatched in two days, while now, in water at a much lower temperature, they required twelve days. Thus the influence of cold in retarding development is greater in the later than in the earlier stages.

4. Part of the eggs were, immediately on their arrival in Kiel, placed in water at $35^{\circ}6$ Fahr., and kept there until hatching.

These did not so regularly as those in previous experiments. The first young fish left the egg on the 28th day, the majority between the 29th and 33rd day, and a few even later. Remembering that, until reaching Kiel on the first day, these eggs were in water at a temperature of from $47^{\circ}12$ to $53^{\circ}6$ Fahr., Dr Meyer concludes that if they had been in water at $35^{\circ}6$ Fahr. from the first, the young fish would not have hatched out until from the 33rd to the 40th day.

5. Eggs were placed in still colder water, in order to ascertain the degree of cold which becomes destructive to herring eggs.

At 32° Fahr. the first young fish hatched out on the 47th day. Many embryos were deformed; but Meyer suggests that the cold may not have been the only cause of this. He thinks this temperature too low, however, to be profitable. Repeated experiments have shown that at $33^{\circ}8$ Fahr. the eggs of the herring develop quite normally; while repeated experiments have equally shown that this is impossible at $30^{\circ}56$ Fahr. At this temperature the yolk becomes opaque, expands, and finally bursts the shell of the egg. Meyer is, however, unable to say if this would be the same in the water of the North Sea, which has a greater degree of saltness, and whose freezing point is lower.

6. Eggs from the Baltic were taken to the aquarium in Hamburg in order to test the influence of the denser water from the North Sea. Temp. $53^{\circ}6$ Fahr., sp. gr. 1.024, April 26.

The eggs were not placed at once in the denser sea water, but were gradually accommodated to it during forty-eight hours.

The first embryos hatched on the 7th May. The time of development was therefore very nearly the same as in the Baltic water of the same temperature, showing that the greater degree of saltness does not exert much influence.

Raising Young Herring from Artificially Impregnated Eggs.

After repeated experiments, Dr Meyer at length succeeded in rearing herring to a length of 72 mm. in the spring of 1878. Soon after hatching the fish kept together like a swarm of bees, and when the sun was allowed to shine on the water they often came to the surface. After one or two days many of the young fish showed a considerable increase in length, the largest measuring 9.2 to 9.3 mm. After three days many had lost the umbilical bag entirely, and showed a widely opened mouth. After five days food could be recognised in the intestinal tract. In some it consisted of fine-grained greenish matter, in most it was composed of the embryos of gasteropods and bivalves of the smallest kinds of *Rissoa*, *Ulva*, *Lacuna*, *Tellina*, *Cardium*, and *Mya*, which at this season abound near the shore in the Bay of Kiel. Sometimes as many as twenty of these embryos were found in the alimentary tract of one young fish. The Copepods, at first of the Nauplius kind, were not quite so frequent. Ten days after hatching Professor Hensen and Dr Meyer found in some of the larval herring a small number of colourless and scarcely visible particles of blood. After the 10th day the young fish began to die off rapidly. The length of the largest one on the 47th day was only 12 mm. while according to observations on young herrings raised in the open waters of the Schlei it should have been about 17 mm. The intestine was nevertheless filled with food nearly all the time.

Hitherto the water had been poured through a thick cloth, so as to keep out any enemies of the herring, but now this was discontinued. The number of Copepods in the water was thereby largely increased, and at the same time the fish began to grow rapidly. Probably it was the want of suitable food which delayed development so much. By this increased growth during the third and following months the artificially-hatched fish at the end of the fifth month reached exactly the same size as those of the same age living in the open waters of the Schlei, mentioned in a former report. This was further corroborated by a number of young herring raised in the Schlei simultaneously with those kept in confinement. I give Meyers' table—

Age Counted from Impregnation.	Artificially Reared.	Naturally Reared.
	mm.	mm.
One month,	10-11	17-18
Two months,	17-19	34-36
Three months,	30-35	45-50
Four months,	48-54	55-61
Five months,	65-70	65-72

Fig. 1

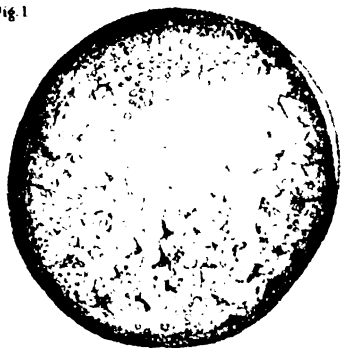


Fig. 2

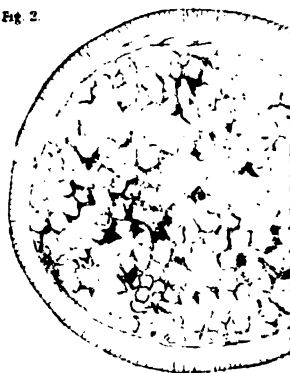


Fig. 10

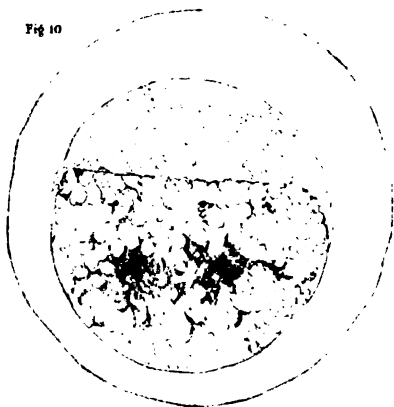


Fig. 15



Fig. 35

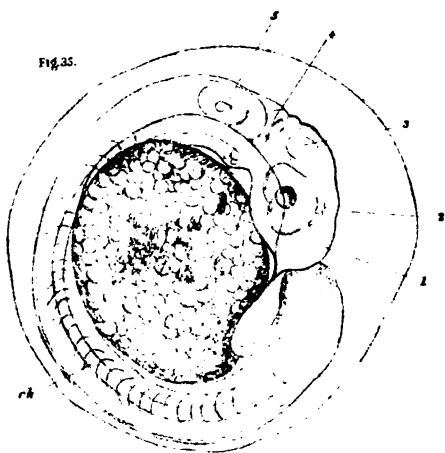


Fig. 46



DESCRIPTION OF PLATE.

(Kupffer's Descriptions).

Fig. 1. Egg immediately after fertilisation. Yolk as yet shows no trace of separation. It forms throughout a conglomerate of rounded-polygonal yolk globules (*Dotterkugeln*) and small strongly refractive, more superficially placed yolk-granules (*Dotterkörner*). The latter show very distinctly in peripheral part of figure. Egg capsule lies closely to yolk only at one spot—on upper side in figure—has water inception begun, and egg capsule is lifted up a little.

Fig. 2. Yolk has withdrawn all round from egg capsule—the space between the two—Eiraum—appears radially striated. Photographs often show this phenomenon at beginning of water inception, where process is going on most actively. I explain it as caused by the radial streaming in of water on all sides into the albuminous solution in the water space.

Germinal substance appears on surface of yolk all round, but not in a quite continuous layer.

Fig. 3. Same egg 10 minutes later. Water space has become wider. Germinal substance moves about over yolk surface in changing fluctuation.

Fig. 4 (7). Another egg in which germinal substance covers more than half of surface of yolk.

Fig. 5 (9). Germinal disc (*Hauptkeim* or *Archiblast*) in more advanced concentration at germinal pole. Broken up yolk particles penetrate into germinal substance.

Fig. 6 (10). The completed disc, forming a segment of a sphere.

Fig. 7 (15). First furrow (*Hauptfurche*) has cut through to basal layer lying under disc, and which is bounded by the dark convex contour next the yolk.

Fig. 8 (23). Disc after segmentation is completed.

Fig. 9 (27). Marginal rim is distinctly marked, and markedly constricts yolk. Middle of blastoderm has become thinner. On left, the embryonal shield is developing out of marginal rim.

Fig. 10 (32). Embryo spans about 315° of egg.

a. Scheitelhöcher: it corresponds to midbrain.

b. Nackenhöcher: it corresponds to boundary between brain and spinal cord.

c. End-knospe.

e. Forebrain.

f. Eye.

g. Protovertebra.

Fig. 11 (35). Embryo of fifth day. Tail is growing out free, and formation of hindgut is beginning. Keel of anterior portion of head has risen up out of yolk. Brain shows all the divisions developed.

1. Hemisphere.

2. Twixt brain.

3. Midbrain.

4. Hindbrain.

5. Afterbrain, with otocyst.

ch. Chorda.

Beneath boundary between hindbrain and afterbrain is seen the cross section of heart tube.

Fig. 12 (39). Successive relations of a cell *b* of disc during its segmentation.

a. Cortical protoplasm.

Fig. 13 (40). The segmental disc (*Archiblast*) lying upon the *Parablast*.

r. Ring (*Ringwulst*) of *Parablast*.

d. Yolk element.

l. Latebra.

Fig. 14 (41). The disc (*Archiblast*) at beginning of its extension. Beneath is Entoderm which has arisen from the *Parablast*.

r. Ring of *Parablast*.

d. Yolk element.

en. Entoderm.

l. Latebra.

Fig. 15 (45). Embryo of sixth day—in the egg.

APPENDIX F.—No. II.

OBSERVATIONS on the SPAWNING of the COD. By J. COSSAR
EWART, M.D., and GEORGE BROOK, F.L.S.

It is now twenty years since G. O. Sars discovered that the egg of the cod floats on the surface of the sea (*Reports on the Loffoden Cod Fisheries*, 1864–69, Christiania), and yet to-day it is the common belief amongst the fishermen in this country that the eggs of the cod pass through their development at the bottom in a similar manner to those of the herring. Sars, in his Report for 1864, states that on the cod fishing ground around the Loffoden Islands he found immense masses of eggs floating on the surface of the water, and proved that they were those of the cod by comparison with eggs pressed from a living female. He also then stated that 'only when the fetus is dead, and the egg shrinks in consequence, does the roe sink to the bottom; and even the young fish recently hatched floats about in a similar manner, with its large umbilical bag attached to it, which for some time supplies it with food.' In his Report for 1865, Sars gives fuller details of his experiments, and draws the following amongst other conclusions:—

1. Only those eggs are fit for impregnation which, by a gentle pressure, may be squeezed out of the belly of the cod-fish; by pressing hard it often happens that eggs come out which outwardly look as if they were mature, but which, seen under the microscope, appear to be surrounded by a thin covering, which contains the blood-vessels necessary to the life of the egg, and which would prevent the fructifying part of the milt from entering the egg.

2. Eggs taken, not only from live fish, but likewise from such as have been dead a short time, will retain life, and may be successfully hatched.

3. When the egg has reached a certain stage in its development it is not so tender, and can stand a good deal of outside influence. I have thus seen eggs hatch which were entirely mouldy outside.'

More recently Mr R. E. Earll ('Cod Fisheries of Cape Ann,' in *Report of U.S. Fish Commission for 1878*, Washington, 1880) has experimented with the cod of the New England coast, and has confirmed many of the statements of Sars. He found, however, that he lost a much larger number of eggs as they approached the point of hatching, and that a large number of vorticellæ and marine algæ were apt to attach themselves to the eggs often in such numbers as to choke the embryo and cause the egg to sink. Ryder ('Embryography of Osseous Fishes,' *Report U.S. Fish Commission for 1882*, Washington, 1884) has also made similar observations, and states that a strong current proves more detrimental in this respect than a weak one.

In a paper on the development of the cod ('G. O. Sars om Vintertorskens Fortplantning og Udvikling,' in *Forhandl. Vid. Selsk.*, Christiania, 1866, this and others are translated in the *Report of the U.S. Fish Commission for 1873–75*, and 1877, Washington), Sars makes the following observations:—'In all spawning schools, even those which came first, the males and females intermingled, which but rarely occurs with other kinds of fishes. Thus, as to the herring, the females always come first.

'Ripe unfertilised ova 1 mm. in diameter, placed in a glass of sea water, at first sink owing to the downward movement of the water, but rise again as soon as the water has become still, to the surface, where they form a closely-packed floating layer.

'The milt, like the roe, is of less specific gravity than the sea water,

'and therefore floats upon the surface as soon as it is poured out. This circumstance may account for the fact that the male fish, during the act of spawning, generally swims deeper than the female, and likewise for the fact that the micropyle is located near the lower portion of the egg, while in other fish which have been observed this condition of things is reversed.'

Professor M'Intosh of St Andrews has also made a series of experiments on the eggs of the cod and other pelagic ova, the details of which are given in the Report of the Royal Commission on Trawling, 1885, and also in an article on 'Fish Eggs' in *Nature* for April 1885.

Our experiments were carried on in the Rothesay Aquarium on fish which had been in the tanks for four years, with the exception of one introduced last October. In the month of February it was noticed that several of the cod had their abdomens distended as if with eggs; but as no fish had been known to spawn in the Aquarium unless recently introduced, the authorities there were not inclined to believe the fish were reaching maturity. However, early in March the fish refused to take food, although up to that time they had been feeding regularly. A few days afterwards a large number of eggs were observed floating on the surface of the water, in an early stage of development. The eggs were so abundant that, when a piece of muslin was placed over the overflow of the tank, hundreds were collected in a few minutes. The temperature of the water was 43° F., and the specific gravity a little over 1.024. The eggs were usually found during the first few days in from the two- to the eight-cell stage at 8 A.M., so that they were in all probability shed early in the morning—about daybreak. Later batches were found which were shed between 6 and 7.30 P.M., and were found at the latter hour with the disc forming. Owing to the great transparency of the living eggs, it is almost impossible to notice them as they rise through the water. The dead eggs, on the other hand, being slightly opaque, are easily recognised as they are carried to and fro by the currents.

For some time before the first eggs reach maturity, and during the early part of the spawning period, the fish not only refuse food but they give up their regular movements around the tank, and swim about in small groups or rest together at the bottom. When under observation they were seen to swim and rest alternately, some resting more than others. Several were often observed moving about for a few minutes, crossing and recrossing under and over each other before settling down in a row at one corner of the tank. While one group was resting in this manner two or three members of a similar group often settled down amongst them—the new-comers fitting in like wedges between those already at rest. After resting for a few minutes the procession through the tank was again repeated.

Sometimes a single female would swim leisurely about for some minutes, attended by a single male. Very often a female would settle down in a corner of the tank and remain at rest until the attendant male disturbed her and caused her to swim about again. The activity of the males was especially evident at dusk and in the early morning; they moved rapidly about the tank, and were constantly forcing the females from their resting places. Apparently it was during these periods of activity that the eggs were shed and fertilised. One day, for example, there were no eggs found on the surface of the water at 6 P.M., while a considerable number were obtained at 7.30, which, as the germinal disc was not completely formed, had without doubt been quite recently shed. In the meantime the fish had been swimming actively about the tank in groups. From the observations made it seems, as was suggested by Sara, that the eggs and milt

are shed while the fish are swimming freely about in the water. During the periods of activity the males have no constant relation to the females. The males swim indiscriminately amongst the females, sometimes over and sometimes under them, fertilising the water through which the shed eggs are slowly rising to the surface.

Eggs were pressed from a ripe female and fertilised artificially. They developed normally, but it was found that a few kept in a small glass cell in a warm room for some hours for observation under the microscope began to show similar abnormalities to those figured by Ryder in the paper already referred to. Too high a temperature has a similar effect on other eggs, but those which float on the surface of the water are naturally more sensitive to a change of temperature. It was found that the females are capable of withholding the flow of ripe eggs to a certain extent in a similar manner to that which prevails amongst the Salmonidæ. Only a limited number of eggs are, however, ripe at one time, and if too great a pressure is applied eggs may be forced out which at first sight appear ripe, but which immediately sink to the bottom and are incapable of being fertilised. These eggs are soon easily distinguished by their milky appearance. The ripe unfertilised egg is also not so transparent as the fertilised one, and with a little practice it is possible to distinguish the fertilised from the unfertilised eggs without the aid of a microscope. As soon as an egg from any cause begins to die, or develops abnormally, the milkiness returns, and the egg sinks to the bottom. Whether the eggs are fertilised or not they float immediately after extrusion, but in the latter case they die and sink to the bottom in from twelve to fourteen hours. During this time no change was observed to take place in the unfertilised egg, the small oil-vesicles surrounding the yolk remaining constantly in their primitive condition. In perfectly still water (sp. gr. 1.024) the eggs float in a dense mass at the surface, the lower layers of eggs sometimes pushing the upper ones slightly above the surface. A strong current carries the eggs with it, and then they become suspended at various depths throughout the water, but none that are living lie on the bottom. At any rate, all eggs found on the bottom are either dead or dying. In connection with these experiments it may be mentioned that a large number of pelagic fish eggs of the cod and other varieties have been dredged from the Fishery Board Station at Tarbert. With the sea perfectly calm most eggs were obtained at the surface; with a slight ripple on the water the best results were obtained by keeping the net just under the surface; in other cases the net had to be lowered two or three feet below the surface, according to the state of the weather. The eggs having a specific gravity only slightly less than that of water do not rise to the surface very rapidly. In one case which was noted it took an egg four minutes to rise through $1\frac{1}{4}$ inches of water.

The milt also has a less specific gravity than sea water, and rises to the surface when it is shed. If forced down by mechanical means it gradually rises again, disseminating slowly as it does so. During the spawning process the water in the tank became slightly clouded by the spermatozoa which were spread through it. The milt is, however, shed in such a thin stream under natural conditions that it is difficult to detect it.

The eggs are capable of being fertilised a considerable time after the fish is dead, as has already been shown by Sars and Earll, and they are also capable of being fertilised some time after they have been shed. Kupffer has fertilised herring eggs twenty-four hours after they had been placed in water and when the outer viscous layer was quite hard, but the eggs of the cod would not appear to have such great vitality.

Light appears also to have considerable influence on the spawning pro-

cess. Under natural conditions the eggs seem to be shed at daybreak and dusk, when the light is not strong, and whether from accident or on account of the light we were unable to get any ova deposited when the gas was lit over the tank.

From the observations made, we feel justified in concluding that the spawn is shed while the fish are swimming about freely in the water, and that the eggs are fertilised at, or as they rise to, the surface—this being facilitated by the micropyle which is always found in the lower hemisphere of pelagic fish ova. To show the facility with which some fish ova are fertilised, an experiment on herring ova may here be mentioned. Three batches of ova were secured from a living female and placed in tumblers, and water added from an adjoining tank. It was intended to fertilise one batch at once, and the other two at fixed intervals afterwards. It was found, however, that although no milt had been added to the second and third tumblers intentionally, spermatozoa must have been introduced with the water, even although this was not taken from the tank in which the herring were kept, as the eggs in these developed exactly like those of the first batch, and ultimately hatched out. Kupffer calls attention to this fact, and points out that, in order to keep eggs unfertilised, it is necessary to get a fresh supply of water direct from the sea.

APPENDIX F.—No. III.

REPORT of the MARINE LABORATORY, ST ANDREWS. No. II.—June 1884 to 31st March 1885. By W. C. M'INTOSH, M.D., F.R.S., Professor of Civil History and Natural History in the University of St Andrews.

1. PRELIMINARY AND DESCRIPTIVE REMARKS.

The fittings for the laboratory, especially the vulcanite pipes, proved a much more serious undertaking than at first anticipated, and it was not till the beginning of November that it could be said that the laboratory was in working order. Yet throughout the previous six or seven months very great advantages had been gained in carrying out the work connected with Her Majesty's Trawling Commission, by the aid of temporary vessels fed with sea water by means of india-rubber tubes from tubs placed at an elevation. The cost of the vulcanite pipes and pump was much greater than arranged for, these items alone nearly absorbing the amount estimated for the whole fittings. It is questionable whether leaden pipes, as now used by Professor Alexander Agassiz, should not in future be adopted, as in addition to the original expense of the vulcanite, the specially skilled labour and the frequent delays in mounting (since parts have to be returned to London for alteration), render this method somewhat inconvenient. Moreover, it must be remembered that a vulcanite pump is a structure which is very liable to injury from sand, a contingency to be expected at St Andrews, where the fine sand is blown into the tanks through the most minute chinks, after filtration of the water through flannel. Considerable alterations were necessary in the wooden hospital to furnish sufficient ventilation in the apartment occupied by the tanks, and to afford space for the vulcanite pump in the engine-house. All these preliminary steps, however, have now been surmounted, and there now exists at St Andrews a comparatively inexpensive laboratory, fitted for work of a kind that it is hoped will prove

useful to the community and to science. Before giving a brief account of the laboratory, it may be mentioned that an open air marine tank of large dimensions, in which tidal water can enter and flow out without permitting the escape of fishes, would be invaluable in connection with the Fisheries' work. The fitting up of shelves for specimens and books, the opening of a northern window in the laboratory for microscopic work, the introduction of a fresh water pipe and sink, additional ventilators, and a few minor changes, would also facilitate labour, and save time. The occasional use of a suitable steam vessel for procuring ova and young fishes, examining the condition of the fishing grounds in the neighbourhood at intervals, both in regard to fishes and their food, and the carrying out of such dredging operations as may be deemed necessary, is also an important desideratum in the future.

BRIEF ACCOUNT OF THE LABORATORY.

The laboratory is fitted up in a wooden building, about sixty feet long, hastily erected a few years ago as a fever hospital. The main rooms (two in number) are about twenty-four feet long by sixteen wide, and the ceiling is lofty. The northern room is occupied by four large tanks, which are fed from a high-level cistern externally, and the waste water issues from the last and lowest tank to the beach. It has been thought unnecessary to use the water more than once, since the supply from the sea is so near and so ample. Besides these larger tanks, many smaller vessels are connected with the supply-pipes, and which overflow into the tanks. The room is ventilated by two western windows, an eastern aperture of considerable size, a similar one over the door, and a small roof-ventilator. The other large room has the same dimensions, and is used as a work-room, gas for water-baths being present in one corner. It is a cheerful and suitable room for the purpose mentioned. An intermediate small work-room, about fourteen feet by eleven, two lobby-presses, and a small closet at the end of each large room, complete the accommodation in the main building.

The separate block towards the west consists of one room and lobby-presses—used at present by the attendant, and which may at any time be made available for increased tank-space. The engine-room to the east holds the gas-engine, the vulcanite pump, and other apparatus. A small shed exists towards the southern boundary, but is beyond the wooden fence, which includes all the other parts of the Marine Laboratory.

Sea water is obtained by a vulcanite pipe with an enlarged and perforated nozzle, which extends under the sand for sixty yards or thereabout, and then emerges into the water. It is pumped up shortly after half tide, and discharges into a separate division of a large underground granolithic tank east of the engine-house. The mouth of the supply-pipe passes through a frame of flannel, so that the water which fills the large store-tank is thoroughly free from sand, by percolating through the flannel and overflowing into the former. By a separate pipe and suitable stop-cocks, the engine pumps from the store-tank to the high-level wooden-tank when required, the sea-pipe meanwhile being shut off.

A small boat for ferrying across the harbour was obtained during the summer, and is a useful though not a new adjunct to the appliances.

SCIENTIFIC RESULTS.

Common Mussel.—One of the earliest subjects of investigation was the reproduction of the common mussel, so abundant in the estuary of the

Eden, near St Andrews. This species was carefully examined from January to July 1884, and a brief account published in the *Annals of Natural History* for February 1885.* It differs from the English oyster in the complete separation of the sexes, each example being either male or female. Moreover, the elements are developed in comparatively small specimens. Full maturity is attained in April, and the organs thereafter begin to show signs of atrophy. The minute ova are developed in the mantle, and are by and by extruded into the surrounding water, where fertilisation takes place. The embryos in their early stages have hitherto eluded observation, but it is hoped that they will be obtained this season from specimens kept in captivity in the Marine Laboratory. It is probable that they are carried about by the currents, since at a later stage—that is, when the valves are developed—the minute mussels are found in myriads at the surface of the sea, and over the entire Bay of St Andrews. In this condition the minute shells present a somewhat circular outline, so that a change to a more elongated shape occurs after they settle down on the rocks, shells, pools, fascines, and other structures. Both in the pelagic and in the latter condition, they form a prominent feature in the stomachs of young food-fishes. The great abundance of the mussels on the rocks adjoining the exit of the main sewage-pipe of St Andrews is a feature of moment. The very great increase in the supply of mussels for bait, which would be obtained by a judicious development of farming operations near the mouth of the River Eden, will form the subject of a special report as soon as time permits.

REPRODUCTION AND DEVELOPMENT OF FISHES.

The season was far advanced (November) before the apparatus was completed, and thus the chief efforts were directed to the preservation of the young food-fishes, so as to watch the rate of growth and habits, and to the observation of such littoral forms as could be obtained.

Viviparous Blenny.†—Many of the viviparous blennies collected in November and December were characterised by the great distention of the abdomen, as indeed previous experience had shown.‡ The opinion of Willoughby, viz., that the species brings forth young in the depth of winter, therefore seems to be most in accord with the condition on the Scottish shores, the well-developed embryos being found in the ovary in November, December, and January. The earlier stages in the growth of the eggs and embryos have not yet been fully observed.

In the fully-developed female the embryos lie over each other in compact masses in the ovarian cavity amidst a quantity of fluid. So far as noticed, the size of the adult does not seem to be connected with the size of the young on extrusion, though the number may be,—larger specimens probably having a greater number of young.§ The yolk-sac is almost absorbed, a slight enlargement only occurring in this region. An account of the structure of the ovary will appear in the *Annals of Natural History* for June, so that it is only necessary to state here that the minute anatomy of the parts fully explains their remarkable functions. The young on extrusion are active little fishes, from 41 to 45 mm. in length, and some when a few days old reach 51 mm. They seek the shelter

* 5th series, vol. xiv. p. 149.

† A short account of the reproduction of this species was communicated to the Literary and Philosophical Society of St Andrews in February.

‡ A very fine example with its young was presented to Prof. Turner for the University Anatomical Museum in 1875. It was procured in November.

§ Dr Shaw, however, states that a female 15 inches in length had young about 5 inches long.

afforded them by stones, crabs, submerged sticks, and similar structures, since they are greedily devoured by the young cod, haddock, whiting, and other fishes (including their parents); indeed, so much are they hunted that this fact alone shows how the numbers of the species are kept in check. When unmolested, as in a separate vessel, the young viviparous blennies stretch themselves along the horizontal branches of zoophytes, feeding on the hydroid polypites, and on the minute sessile-eyed crustaceans that lurk amongst them. The sides of the young are mottled with dark brownish touches on pale olive, the markings beneath the dorsal fin somewhat resembling Arabic characters. A darker band runs along the lower lateral region, and on this are a series of silvery spots. The dorsal fin is marked by dark touches at somewhat regular intervals, as in the adult.

Catfish.—The somewhat close approach made by the *catfish* to the foregoing species rendered the examination of its ovaries noteworthy in this connection. In shape these considerably differ, since they are separate anteriorly, connate posteriorly, as occurs in many fishes. Their walls are much more massive. A considerable similarity, however, exists in the arrangement and connection of the ova with the ovarian wall, the cavity forming a single chamber, bifid in front, and having the eggs attached to various membranous folds like large flattened bunches of grapes. In a female procured during the Trawling Experiments on the 29th August, the majority of the ova were about 4 mm. in diameter each being attached by fine thread-like bands of tissue. The membranous parts of the folds to which the ova were attached showed in addition numerous microscopic ova. The vascularity of this tissue is slight, and in striking contrast with the villous processes in the ovary of the viviparous blenny. The ovary of a specimen procured in February showed an unusually rough appearance, from the presence of numerous large ova (5 mm. in diameter) amongst the smaller. Some of the larger ova were quite free, and apparently ready for extrusion; while others were fixed to the membranous pedicles and folds, which presented many branching blood-vessels, as well as more minute ova. The latter seem to be developed everywhere in the indifferent tissue of the ovary and its villous processes. From the variable size of the ova, in this instance, the spawning period probably extended over a considerable area. The ova, further, are evidently deposited on the bottom. In other examples the nearly uniform size of the majority would show that many are deposited simultaneously.

OVA OF THE HERRING.

On the morning of the 5th February, a boat from the fishing ground near the Bell Rock reached the harbour of St. Andrews, having on deck a quantity of the eggs of the herring, which probably had been shaken from the nets, and thus had been several hours in the open air. Some of the eggs were roughly scraped up by the hand, and brought in it to the Marine Laboratory, where they were placed under a tiny trickle of sea water. The first embryos emerged from the eggs on the 6th March about noon, and thus a month elapsed from the date of deposition. This lengthened period was probably connected with the low temperatures of the season. The main feature of interest in connection with this experiment is its relation to the statements made as to the injury or disturbance of the ova of the herring by the sole or ground-rope of the trawl. As a rule, fish-eggs that are deposited on the bottom, such as those of the herring, *Cottus*, lump-sucker, and Montagu's sucker, are by no means delicate, and if nothing more befalls them than being brought on deck by the trawl, and subsequent tossing overboard into the sea, they will be

little worse for the accident. It is by such means that many of the young fishes have been procured for observation. Slight irregularities of the bottom would suffice for the protection of the majority. On the other hand, the newly hatched embryos of the herring are much more liable to succumb to pressure of any kind, though of course they are more capable of getting out of its way than ova. It is a fact of interest in connection with this subject, that there does not seem to have been a diminution in the catch of herrings during the last few years, and when beam-trawling has been on the increase. The young herring, on its escape from the egg, is much less active and vigorous than the young of other fishes with fixed eggs, such as Montagu's sucker, for the former were unable to make much progress above the bottom for some days, while the latter at once disported themselves throughout the water—shooting here and there like ephemeræ in the summer atmosphere.

OVA OF THE SHORT-SPINED COTTUS.

So little definite information has hitherto been in the hands of zoologists in this country with regard to the spawning of this species, that the following passage in the recent and excellent work on British Fishes of Mr Francis Day, F.L.S., may be quoted:—'*Breeding*.—In Greenland it has been observed 'to deposit its eggs on the sea-weed in December and January. Its eggs 'are very small, and in this country are extruded during the spring in the 'sand or pools in the rocks. The male is said to make a nest of sea-weeds and pebbles for the reception of the spawn, while he is believed 'to watch over, as well as protect, the young when hatched.' On the other hand, Professor Alexander Agassiz states that the ova of certain American Cotti are pelagic. As soon as the tanks were in working order numerous examples of the short-spined Cottus (*C. scorpius*) were procured, but it was not till the 1st of March that the first female deposited its ova. This specimen had been isolated in a glass vessel, so that its movements were somewhat limited, and it is probable, therefore, that the deposition may have been hastened. In a few seconds this specimen deposited a large quantity of skin-coloured (faint pinkish) ova. These cohered firmly together, forming a mass like that of the lump-sucker, though of course the ova are much smaller, viz., about 1.5 mm. Next morning one of those in the tank likewise emitted a mass of similar ova of a beautiful roseate hue. Since that date others have at various times deposited ova, which varied in hue from pale straw to a deep red. They firmly adhere together, but yet leave a series of cavities, so that the whole, as in *Cyclopterus*, resembles a sponge. The water is thus retained in considerable quantity, even though the eggs are removed from the sea, a provision of some importance in the case of those between tide-marks. The egg-capsule is thick, tough, and resistant, and shows the facets or processes by which it adheres to surrounding ova. Under a high power the surface of this coat is minutely punctured. None of the ova deposited in the tanks seem to have been fertilised, so that the development could not be pursued. Towards the end of March (20th), the ova (reddish) were procured in an advanced stage of development from the rocks.

The spawn deposited in the tanks was greedily eaten by many of the Cotti.

On examining the ovaries of the large female Cottus which first deposited its spawn, a few ova were still present.

So far as one may judge from a preparation of the ova of the long-spined Cottus (*C. bubalis*) from Jersey, mounted by Sinel & Co., they differ from the preceding in having the egg-capsule marked by somewhat

regular conical papillæ or elevations on the surface, but probably the mode of preservation may have something to do with this appearance.

The short-spined *Cottus* is one example of those fishes in which the ova attain nearly uniform size at the same time in the ovaries, and are extruded simultaneously or nearly so. At the full period, indeed, the ovaries are heart-shaped, only a slight sinus occurring in the middle line anteriorly, while the posterior end is bluntly conical. Numerous specimens are still under observation.

OVA OF OTHER FISHES.

Armed Bullhead.—The nearly ripe ova of this species (*Agonus cataphractus*) occurred in a specimen trawled in St Andrews Bay (where they are common in the sandy ground) on the 12th March. They presented a pale salmon-colour, and were about 1·3 mm. in diameter, and thus were smaller than the ova of the short-spined *Cottus* (*Cottus scorpius*). They are somewhat softer than the eggs of the latter, and have a thinner capsule, which is minutely dotted all over with very fine points, somewhat regularly arranged in rows. They resemble eggs which are deposited on sea-weeds, stones, and other structures. A male showed fully developed sperms at the end of January.

Bimaculated Sucker.—The eggs of this species in July are somewhat regularly arranged inside the valves of dead specimens of *Solen siliqua*, and they cover several square inches. The eggs do not touch, but are firmly attached almost at regular distances to the smooth surface. In one instance the eggs occurred with the adult inside the hollow bulb of *Laminaria bulbosa*, and as the embryos were far advanced it is probable that, as Mr Hyndman observes, the adult remained in charge of them. The eggs were less regularly arranged inside the laminarian bulb than on the shell; probably because the surface was uneven. The egg-capsules of this fish are distinguished by very evident dots or punctures.

Montagu's Sucker.—This is almost the only kind of fish-ova obtained by the local trawlers (liners in their fishing-boats) in February, March, and April, attached to such zoophytes as *Hydrallmania* and *Sertularia* and also to red alge. The men work in comparatively shallow water. These ova are much smaller than those of the short-spined *Cottus*, and are distinguished by their coarsely-punctured, indeed, almost tessellated appearance. They are of a pale straw-colour, and firmly adhere to each other and the zoophyte. Even after considerable exposure on the deck of a boat they are readily hatched in the laboratory. The embryos are remarkably active, and are very much more highly developed than those issuing from pelagic eggs. They at once swim actively through the water.

OVA AND FOOD OF THE LUMP-SUCKER (*Cyclopterus lumpus*, L.)

The first specimens were brought to the laboratory on the 28th February, but as some of them had advanced embryos, it is clear that deposition must have occurred some time previously. This fish seeks the rocky shores to spawn, if, indeed, it does not live there throughout the year. Both sexes are procured at extreme low water with the hand-net, and males were especially common near the masses of eggs on the stones. The reddish coloration of this sex is conspicuous at the breeding season, and the same feature is observed in the short-spined *Cottus*. The masses of the eggs of the lump-sucker are somewhat difficult to deal with in a laboratory, since they speedily acquire a fetid odour, and injure other forms. None have yet been hatched (naturally) in the tanks, though many thousand are under observation at this moment. When the young

are removed artificially from the eggs during the later stages they swim actively in the water. The stomachs of the majority of the specimens at St Andrews have hitherto been found empty, but in a large female procured in March, and which emitted on dissection a mass of amethystine ova—fully matured—the stomach was distended with fine specimens of *Nereis pelagica*, L.

PELAGIC OVA.—GENERAL REMARKS.

During the experiments on behalf of Her Majesty's Trawling Commission, many pelagic (or floating) eggs were examined, and several added to the list of those already known. Foremost of these were the eggs of the cod, which were not only found in great abundance near the surface of the sea, but were also removed from the adult females, fertilised, and hatched. The details of the observations are given in the Report formerly mentioned. The cod of the eastern shores of Scotland seem to be in full maturity in April, though, of course, the period stretches considerably on either side, since the spawning of such fishes is a function that is performed gradually. Those familiar with pelagic eggs will not be inclined to give much attention to the notion, that they float in virtue of the oil-globules they contain, since in the common forms, e.g., cod, haddock, flounder and turbot, no oil-globule is present. Masses of oil-globules indeed are more characteristic of ova that lie on the bottom, or are fixed to submerged stones and rocks. The pelagic ovum of the gurnard, however, is one in which a single oil-globule occurs, and Mr Brook has found such also in *Motella* and *Trachinus*. The abundance of oil again does not in any degree cause the eggs of the salmon or trout to float. One feature noticeable in most pelagic eggs is the delicacy of their investing capsule (*zona radiata*), and the crystalline translucency of the yolk-mass. Another is the fact that the embryos produced by such eggs appear to be only partially developed, some issuing into the surrounding water devoid of mouth and functional digestive system, without a trace of blood-vessels or blood, their tiny bodies being nourished by the yolk-sac on the ventral surface. The minuteness and delicacy of the young of the gadoids and flounders (using the latter term broadly so as to comprehend the Pleuronectidæ), and the difficulty of rearing them in confinement after the absorption of the yolk-sac, are serious obstacles to the successful spread of such forms by artificial means in exhausted waters. Much information, however, will yet be obtained on this head. Meanwhile the temporary closure of one or two well-defined bays would afford invaluable data, especially in regard to the important flat fishes. Not only would the general rate of growth be observed, but the practicability of introducing or increasing the rarer forms, such as the sole, halibut, and turbot, would be tested in both ways, viz., by the spread of ova and embryos, and by the addition of the adults of both sexes. Sanguine views cannot at present be entertained on this head; for, as already stated,* 'the intricate network of circumstances, on which success depends in a sphere like the ocean, renders extreme caution necessary, even in suggestion.' The American experiment of the artificial hatching and dispersion of cod is not sufficiently pronounced to afford a reliable stand-point. The whole subject, indeed, must be much more fully and carefully investigated by competent observers. While it is comparatively easy to regulate the condition of the fresh waters of a country in this respect, it is one of the most difficult to apply the same measures to the sea.

* Trawling Report, p. 379.

The pelagic ova specially examined last year, during the investigations for Her Majesty's Trawling Commission, were those of the cod, haddock, whiting, grey gurnard, common flounder, turbot, sole, lemon dab, common dab, and long rough dab. This year already multitudes of the ova of the haddock and those of the common flounder have been under observation, and more complete details of their development, with accompanying careful drawings, have been made by Mr Edward Prince, the natural history prizeman of 1884, at the Marine Laboratory. Moreover, the free access afforded to the fishermen of St Andrews has given them unusual opportunities of becoming acquainted with pelagic eggs. Some of them, indeed, have removed the ova from both haddock and common flounder, fertilised them at sea, and courteously brought them to the Laboratory. Very cordial aid in this respect was, however, first obtained from Mr Scott, the manager of the General Steam Fishing Company of Granton, one of whose trained skippers (formerly a skilled liner) had profited most creditably by the experience of last year. The rapidity with which the ova of the common flounder come to maturity and hatch is noteworthy. The condition of the young fishes, however, as already mentioned, is very rudimentary. The period of development of the haddock and the cod in cold weather seems to be about the same, viz., from 13 to 20 days, but with a higher temperature the time is considerably lessened; for instance, cod have been hatched in 8-10 days.

The placing of marine fishes which have pelagic ova in confinement at the spawning period is not always successful in regard to results. Thus, several large specimens of the common flounder were consigned to a spacious wooden tank. The females in a few weeks presented great distention on the coloured (upper) side. One has already died in this condition, the enormously distended abdomen containing a mass of eggs, chiefly ripe. In a state of nature, the ripe eggs gain exit to the exterior gradually, and this dangerous distention is avoided. In confinement, on the other hand, the fish is deprived both of healthy exercise and food, and the reproductive process is interfered with. In a living form in this condition considerable difficulty was at first felt in extruding the ova, and most of these were dead, though approaching maturity, if indeed they were not mature. Every egg ready for extrusion floats in a healthy flounder just taken from the sea, whereas very few do so in such an instance as that just mentioned. Some of these eggs from a distended captive specimen have been fertilised, and it will be interesting to observe the result both with regard to their vitality and the condition of the embryos.

ON THE YOUNG OF THE LING.

In the Report for Her Majesty's Trawling Commission, allusion was made* to the immature examples of the ling that had come under observation. These had for the most part been procured by the hooks of the liners. About the middle of December a very young specimen in excellent preservation was found in a pool near the commencement of the East Rocks. Its striped condition affords such a contrast to the boldly spotted state of the young cod, that it is desirable to record it. The example measures $3\frac{1}{2}$ inches in length, and its coloration is striking, for an olive-brown band passes from the tip of the snout in a line with the middle of the eye, straight backward to the base of the caudal fin-rays. The pale ventral surface bounds it inferiorly, while dorsally a stripe with a beautiful opaline lustre runs from the tip of the snout over the upper

* *Op. cit.*, p. 360.

part of each eye to the base of the caudal rays. The latter band is opaque-white on the tail, and it gives the fish a characteristic appearance. The dorsal fins are well marked, the first presenting a distinct black speck posteriorly, and another black pigment-patch occurs at the end of the last division. The dorsal line from the brain backward is distinguished by a narrow edge of dull orange or pale olive, and this brings out in relief the colours formerly mentioned. The little ling is thus a beautifully striped form, and in strong contrast with the spotted or tessellated condition of the young cod.

Young Eel.—While digging for sand-eels near low water, a young eel about $3\frac{1}{2}$ in. long was found in the sand at the beginning of April. The whole fish is extremely translucent. Anteriorly, however, a symmetrical pale greenish colouration commences at each eye, and passes backward and slightly outward, keeping exteriorly to the translucent cranium. Behind the latter is a similar greenish band, broad at first, and extending backward along the anterior end of the vertebral column. Blackish pigment occurs in the eyes; and there is a small patch of the same colour in the tail, which presents a dilated marginal fin superiorly and inferiorly, so as to be broadly lanceolate. At the base of the brain also is a little dark pigment, and a line of the same colour runs along the dorsal surface of the vertebral column to the tip of the tail. This colouration is probably due to the pigment developed in the lining membrane of the canal. The dorsal fin begins some distance behind the pectorals, and thus differs from that in the adult conger, which commences at the last quarter or end of the pectorals. The projection of the mandible is also pronounced, a feature also diverging from the condition in the adult conger. The blood is faintly pinkish, and the coloured corpuscles can be seen rushing along the aorta and back by the cardinal veins. The opercular region presents a somewhat radiated appearance by transmitted light. It is interesting to find that such immature forms seek safety in the moist sand. The translucency of their bodies will also to some extent secure them from observation.

SCIENTIFIC WORK BY VISITORS.

During August and September, Professor Ray Lankester, F.R.S., of University College, London; Professor Hubrecht of Utrecht; and Mr Alfred Gibbs Bourne, Assistant Professor of Zoology in University College, London, worked at the Marine Laboratory.

Professor Ray Lankester was chiefly occupied with a remarkable Gephyrean (*Golfinga M'Intoshii*, Lankester), which was found many years ago amongst annelids procured off Montrose, and sent me by Dr Howden. He has since been supplied with numerous chitons for researches on this curious group, as well as examples of *Natica*—so common on the west sands.

Professor Hubrecht came specially to study the structure and development of the Scottish Nemerteans, which occur in considerable abundance at St Andrews. His former labours in the group at the Zoological Station at Naples, which have given rise to many valuable treatises beautifully illustrated by his pencil, are well known and appreciated.* Moreover, several consignments of living Nemerteans were sent early this year to Utrecht. Those by post unfortunately perished; but a large number forwarded by steamer, and specially looked after, reached him in good condition. He was thus enabled to watch, and is still watching, the various stages in the development of the eggs and embryos, which could

* He is also now engaged on the Nemerteans of the 'Challenger.'

not be accomplished last autumn. There is no greater difficulty in sending such living forms to the Continent than in bringing them alive from the Channel Islands to Scotland in August, after a week's delay on the journey.

Mr A. G. Bourne, Assistant Professor in University College, London, found ample means at his disposal for investigating the development of the Dog-whelk, the egg-capsules of which abounded on the rocks and stones in August and September. *Corymorpha* and other forms were also examined.

Mr Alexander Thomson, first prizeman in zoology this year, has paid considerable attention to the ova of Montagu's sucker,* and other fishes; while the ordinary students of zoology, and not a few others, have had many opportunities of becoming familiar with the habits and structure of marine animals.

GROWTH OF FISHES AND GENERAL REMARKS.

The growth of the young cod in the laboratory has been noteworthy; thus, for example, a specimen procured off the rocks in July gained about 4 inches in eight months, losing its barred condition, and assuming the usual dull greenish dorsal hue of the adult. The voracious tendencies of the species is no less marked in the young than in the adult. The appearances of the young cod are given in the Report on Trawling.

The young haddock and whiting show a proportional rate of growth, and both live fairly in confinement.

Small specimens (3-4 inches) of cod, haddock, and whiting occur in St Andrews Bay from November to March, besides the other periods noted in the Trawling Report. These are occasionally caught on the haddock-hooks, as formerly mentioned, and also now and then in the local trawls when they are plugged by masses of sea-weed and sand.

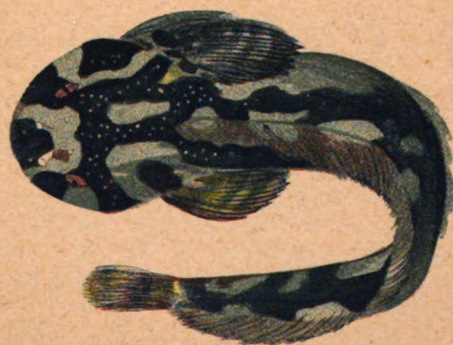
Amongst the rarer fishes under observation in life was the tadpole hake, caught by the liners, and one of which is still in fair condition.

Dead examples of the lesser forked-beard, John Dory, and Müller's topknot, were forwarded by Mr Scott of the General Steam Fishing Co., Granton.

A remarkable variety of Montagu's sucker (see figs. 1 and 2) was procured at the rocks in March. The following description by Mr Prince probably agrees with one of the varieties (*picta*?) described by Collett. In confinement these fishes are aggressive, biting at each other most pertinaciously, and worrying the weaker so much that death ensues.

In general external configuration the specimen differs little from *Liparis montagui*. The dorsal and ventral median fins, however, are broader and more erect even when the creature is at rest than in the common examples. The pectorals also are very prominent in outline, though not larger than in the latter. Its length is $3\frac{3}{4}$ inches from tip of snout to tip of tail. The skin is not smooth as in the common specimens, but dotted over with delicate epidermal prominences of a pale hue, most numerous upon the dorsal region. The head is flat, and exhibits a slight depression between the eyes. The descent to the capacious oral opening is very sudden. The cheeks have a puffy appearance, and the nasal openings rise in the form of protruding flesh-coloured tubes surrounded by a cincture of darker colour near the summit. The facial region presents an irregular surface, being traversed by sinuous depressions and showing tumid prominences. The snout is broad and rounded. Ten

* An account of this fish will be communicated to the British Association at Aberdeen.



MONTAGU'S SUCKER, VARIETY.

mucous apertures open upon the face, six of which form a row along the lobate tegumentary flaps overhanging the upper jaw. A pair also occur below, and a pair above (and slightly internal to) the nasal openings. The eyes are prominent and placed somewhat laterally, and the iris is of a brick-red colour. The body, which anteriorly is broad, becomes laterally compressed and attenuated posteriorly. The dorsal median fin arises suddenly at a point above the gills, and is elegantly dentate at its origin and for a little distance, but for the greater part of its length it is strongly spinous. The anal fin originates more gradually than the dorsal, but it is strongly rayed throughout, and it terminates at the origin of the caudal fin. The latter is not very broad, and is slightly rounded at the posterior margin. The pectoral fins are massive and expanded, the rays being strong and spinous, while the fin-membrane is unusually thick and opaque. Each pectoral fin continues by a series of strong fin-rays to the ventral surface, passing anteriorly and uniting in the middle line to form the anterior margin of the sucker, which exhibits the usual character. These rays diverge posteriorly. A pale tinge of pink occurs upon the suboral, pectoral, and ventral regions, but the prevailing ground colour of the fish is a deep blue-black, variegated in a striking manner by a delicate greyish blue coloration. The latter shows almost complete bilateral symmetry of disposition, and at a cursory glance has the effect of alternate vertical bands of pale blue and the deep ground colour. The arrangement of the pale blue coloration is, however, much more complex. A patch runs up between the nasal tubes and the eyes from the margin of the upper jaw on each side. These unite in the middle line above the snout, and form a rude horse-shoe figure. A bold patch descends from the lower side of each eye to the mouth, and an elongated belt runs from the eye over the opercular region. On the upper surface of the head an irregular patch occurs on each side. A long band passes from the root of the pectoral fin (anterior), and extends two-thirds of the length of the body, though interrupted midway. A bifid patch is seen near the root of the tail, and five or six touches at intervals along the base of the median fins, dorsal and anal. The patches also extend partly over the fin-membranes, as well as the dorsal and ventral (lateral) regions of the trunk. The caudal fin shows alternate bands of dark colour and a light yellow tint, a similar alternation of black and yellow also sparsely occurring on the dorsal and pectoral fins.

The young of the common herring are sometimes brought to the harbour from the Baltic in fresh water, and they live and thrive for a considerable period in this medium, dying indeed if placed in sea water. They refuse mussels, but apparently consume small worms. Several have been in the laboratory since last autumn.

Comparatively little attention has yet been paid to the development of invertebrate forms, mainly from want of time, but there is an ample field. Amongst other forms which have been observed, however, are the common cross-fish, *Asterias rubens*, the eyed *Cribrella*, the northern stone-crab, lobster, common swimming crab, common shrimps, various nudibranchs, and zoophytes, both hydroid and zoantharian. It is remarkable that no large example of the common cross-fish has been found bearing ova. All those procured with ova, both now and in former years, have been small, ranging from an inch and a quarter to an inch and a half across the rays. Such ovigerous forms are easily recognised, as the elder Sars long ago taught us, by the drawing together of the rays and the raising of the disc upwards after the manner of a table. Those at St Andrews have generally been found under stones in tidal pools, and are so easily reared through their metamorphoses, that a student

keeping them in an unchanged vessel of water has no difficulty in developing the common species to the five-rayed condition. *Cribrella*, again, seems to be much less rapid in development.

Glutinous Hag.—Numerous examples of this form were procured in the beginning of April, attached to the lines of the fishermen who had been working on the soft ground off St Abb's Head. They had greedily taken the mussel-bait, indeed, in some of them, the foot of the mussel still projected from the mouth. Nothing is more common than that they should thus be captured. The notion of my friend Surgeon-General Day,* that such an instance must be extremely rare, therefore requires qualification. The longest example was $17\frac{1}{2}$ in., and the average of a series of about twenty was 14 in. The reproductive organ was in full activity in April, the females having from 16 to 20 eggs, some of which reached about 19 mm. in length and 6.2 mm. in breadth.

The ova of *Myxine* seem to have been observed by the fishermen only in the mucus with which they surround themselves, and they may have been extruded by force. None have been found attached to any foreign body, and no more successful result followed the use of the trawl on the ground frequented by them last year.

Amongst the fishes in which the reproductive organs have been examined are the five-bearded rockling (*Motella mustela*, L.), which at the beginning of February showed only minutely granular nucleated cells in its undeveloped ovaries. In the lesser launce (*Ammodytes tobianus*), the ovaries were so small in the beginning of April that a considerable time must elapse before ripe eggs are present. It was mentioned in the Trawling Report† that larger numbers of minute sand-eels, 15–16 mm. in length, were caught in the tow-net amongst the pelagic ova of the cod and other forms, and the remark was made that they probably spawned in spring. The present observations on the lesser launce would seem to indicate that either two periods for spawning exist, or that the forms in the deeper water vary in this respect from the littoral kinds. At the end of March, the ova in the ovaries in a large eel were microscopic. The reproductive organs of the gunnel (*Centronotus gunellus*) are small in February.

DISEASES OF FISHES, &c.

Multiple Tumours in Plaice and common Flounders.—In the Trawling Report allusion was made‡ to the fact that haddocks affected by the gill parasites are generally much out of condition. In the same way the common flounder of the Thames, labouring under the multiple tumours hereafter to be described, are frequently covered with *Caligi*; and the same forms swarm in the sickly green cod (*Gadus virens*, L.) which come on shore at the west sands in summer.

Several examples of the common flounder (*Pleuronectes flesus*) were affected with the peculiar multiple tumours alluded to by Lowe in specimens from the Ouse, and, as above mentioned, they have also been seen in the Thames and other parts. The same disease is met with in the plaice at St Andrews. Lowe§ describes the former as 'affected with a peculiar skin disease resembling epithiloma, large fungous growths 'cropping out over the whole body, the granulations large and roe-like 'under the microscope, consisting of large nucleated cells.'

In a plaice, for example, the coloured surface was crowded with the

* *Fishes of Great Britain*, part viii. p. 365.

† *Op. cit.*, p. 360.

‡ P. 357.

§ Day's *Brit. Fishes*, part v. p. 86.

small rounded tumours which resembled shot.* They also occurred on the dorsal, ventral, pectoral, and caudal fins, and on the white surface. They are firmly fixed to the skin, and give pain to the animal when they are interfered with. Moreover, they are vascular, free hæmorrhage occurring when they are injured. The isolated tumours range from 1·7 mm. to 1 mm. and less. The larger masses when bisected show a series of smaller areas, the whole being composed of multiple tumours, mostly of the same size. When cut into in the fresh state a whitish creamy substance exudes, which under a power of 400 diameters is minutely granular, no distinct cell-elements being visible, though fine fibrillæ occur throughout the field as if the fluid were coagulable. In section the large tumours present a series of loculi, or spaces filled with the granular creamy fluid. Each chamber is cystic, presenting a firm hyaline wall of considerable thickness, within which is the granular semi-fluid contents. The stroma exterior to the hyaline coat is chiefly fibro-granular. Amongst the larger cysts are numerous smaller forms in course of development, the thick translucent hyaline wall being conspicuous.

The flounders affected by this peculiar disease are considerably emaciated.

APPENDIX F.—No. IV.

NOTE on some of the SPECIMENS sent in by the Officers of the Board. By GEORGE BROOK, F.L.S.

1. *Herring attacked by Squids*.—On the 8th of February a letter was received from Mr George Thomson, the Fishery Officer at Lybster, along with some specimens of herring that bore unmistakable signs of having been attacked by squids. The following is an abstract of Mr Thomson's letter:—'The specimen herring sent was caught on 'the night of the 14th or morning of the 15th January 1885, on 'the usual fishing-ground a mile or so off Lybster, in 25 fathoms of 'water. Of some twenty crans of herring landed up to this date, fully 'two-thirds of the fish were more or less marked like this specimen, while 'not a few were very much cut up and partly eaten on the back of the 'neck by the cuttle-fish.' The specimen referred to had two or three bands on each side from which the scales had been entirely removed, and at the shoulder there was a scar as if the mouth of a squid had been applied there for some time. It appears that squids of the genera *Loligo* and *Ommastrephes* were very common on the coast at Lybster during the months of November and December 1884, and up to the 18th of January 1885. In the Bulletin of the United States Fish Commission, issued January 22, 1885, there is an account of squids attacking both herring and mackerel in America, which appears of sufficient interest to quote at length here:—

'Writing from Gurnett Life-Saving Station, Plymouth, Mass., November 15, 1884, the keeper, Mr John F. Holmes, states that during the 'last three or four weeks large schools of squid and small herring, locally 'known as spiraling, have frequented the waters of that vicinity, and quite 'often during the night more or less have been thrown upon the beach. 'This includes both squid and herring, the herring predominating. 'Many of the herring were found bitten on the back at the point where

* Or, as the fisherman who captured it said, 'it carries its eggs on its back'

'the head joins the body, some of the heads being bitten entirely off, and 90 per cent. of them being bitten in about the same place. The squid are quite large, some of them measuring 26 inches from the end of the longest tentacle to the end of the tail. Recently, between 6 and 8 o'clock P.M., the water being very smooth, a large school of what was supposed to be spirling was seen close to the shore. Two men ran into the surf and kicked more or less specimens on the beach. These proved to be squid and spirling, each squid having a spirling grasped in its tentacles, and each having already gnawed a hole in the spirling. The beach, for a distance of six or eight miles, has been strowed with these spirling for some time. More or less squid and some mackerel have been found among them. The spirling and mackerel had been bitten in the manner described in almost every instance. Upon examination, some of the squid were found to have their suckers stuffed with minced herring.'

Commenting on the above, Captain Collins, under date of November 21, 1884, says:—'The facts are not entirely new to me, so far as the habits of the squid are concerned. It is not an uncommon thing to see squid attack capelin on the Grand Bank; and so extremely voracious are these animals that they have sometimes been caught on a jig while still clinging fast to a capelin which they held in their beak and arms. It would appear from this that they are in the habit, at least occasionally, of attacking a second small fish before they have eaten the first they caught. In former years when I was engaged in the mackerel hook fishery in the Gulf of St Lawrence, squid sometimes—particularly towards evening—came alongside of the vessel with the mackerel, and I have no doubt that they often attacked the latter; at least they would often fasten on to a mackerel that was being hauled in on a jig. This we were able to see as the fish came to the water's surface, but we could of course only surmise what the squid might do deeper down, when they were out of our sight.'

'I notice in the *Cape Ann Advertiser* of yesterday the following, which is corroborative of the above:—

'The mackerel fleet, some fifteen sail, which hoped to intercept the mackerel schools along the Cape shore as they came out of the Bay of St Lawrence, and thus secure late fares, have been disappointed, as the mackerel have been destroyed by the immense schools of squid which infest that shore.'

'May there not be in this a possible solution of the scarcity of mackerel some seasons as compared with other years immediately preceding?'

2. *Callionymus lyra*, the Dragonet.—Various specimens of this interesting fish have been sent in from Stonehaven and elsewhere, and many smaller ones have been found in the stomachs of the cod and other fish from various parts of the coast. This species is usually common around the coast, being generally found at a depth not less than 15 or 20 fathoms, and on a sandy bottom. It is said, however, to come nearer in shore to spawn, and in May 1883 I caught two specimens at Redcar, on the Yorkshire coast, quite close to the shore in only 2 fathoms of water.

The male and female of this species were formerly considered as two distinct species, and indeed besides the differences in the fins they often present quite a different appearance in colour and markings, even when side by side. There are at present some specimens in the Rothesay Aquarium, which form an interesting study in this respect. When the fish are placed on silvery sand and in a strong light, both male and female

have a power of imitating the colour of the sand to a marvellous extent. The body is then of a uniform sandy grey, with a faint dark line on each side of the dorsal fins, very much like the figures given in Day's *British Fishes*. They are then so nearly the colour of the sand that, but for the large quaint eyes, they might easily be overlooked, the more so as they usually remain quite motionless at the bottom. In a deeper tank, with a more moderate light and with overhanging rockwork, the beautiful opalescent blue bands and spots so beautifully delineated in Couch's figures make their appearance. The male is then usually lighter in colour than the female, and has more of the pale blue patches. The females, indeed, do not all show these blue streaks and patches, and when present they are never so brilliant as in the male. On a bottom of flint gravel from Brighton both sexes lose the blue patches almost entirely, and the body has then a ruddy brown colour, mottled with darker spots and patches of a similar class. On a bottom composed entirely of mussel shells I have seen this species almost jet black; a certain marbled or mottled character was, however, always retained, and there was always a brilliant white band just over the eyes, which gave the fish a most grotesque appearance. I have had no opportunity of examining the pigment cells of this species, but it would appear from the above experiments as if *Callionymus* had even a greater power of mimicking the surrounding colours than the flat fishes which have been so ably studied by Professor A. Agassiz. A large number of British fishes, particularly the rock fishes, possess this power in a variable degree. *Liparis vulgaris*, for instance, is almost a pale flesh colour, with faint longitudinal lines, when it has been some days in a glass vessel in a strong light, whereas, when found under stones and amongst dark weeds and incrustations, it is often so dark a brown as to be almost black. In no species, however, which I have observed are the changes of colour so complete and so sudden as in the dragonet.

3. *Rare Fish*.—During the past year no specimens of great rarity have been received. A fine specimen of the great fork-beard, measuring 18 inches in length, was sent in by the fishery officer at Berwick, and another has also been secured by Dr Traquair for the Museum of Science and Art. Last year also a specimen of this species was sent in from the Aberdeenshire coast. Without being a great rarity, it is only occasionally captured on the Scotch coast, and is worth recording. Mr Doull also sent from Berwick a very fine specimen of the lumpsucker (*Cyclopterus lumpus*), measuring $19\frac{1}{2}$ inches long and $13\frac{1}{2}$ inches deep. This, of course, is a common fish, but it is seldom such a large one is secured.

An interesting specimen was sent in by the fishery officer at Lybster, in January last, in the form of a sand-eel embedded in the liver of a haddock. This specimen is being examined by Dr Barrett.

4. Various specimens of fish-eggs attached to zoophytes (*Sertularia*, *Hydrallmania*) have been sent in by the fishery officers. They were mostly brought up by the haddock lines from deep water, and are supposed to be herring eggs by the fishermen. It is, of course, difficult to identify such specimens, but there appears no doubt that many of them are not herring eggs. It is proposed, however, to withhold a report on these eggs until further investigations have been made.

APPENDIX F.—No. V.

NOTE on the LIVER of a HADDOCK in which a Sand-Eel was partly Embedded. By W. H. BARRETT, M.B., C.M., Junior Demonstrator of Pathology, University of Edinburgh.

The following note accompanied the portion of liver containing the eel:—

'Part of haddock liver with sand-eel embedded. The haddock was caught February 13, 1885, $1\frac{1}{2}$ to 2 miles off Swiney to Forse, in 25 to 28 fathoms; rocky bottom. Caught 6 A.M. to noon. Roe fish, 11 inches long. The little food in stomach consisting of small crabs, star fish, &c.
(Signed) GEORGE THOMSON, Fishery Officer.
'*Lybster*, Feb. 13, 1885.'

Embedded in the haddock liver (fig. 1, *a*), the dorsum of the fish towards the liver substance, the ventral aspect superficial, being just on a plane with the general surface of the organ, is a sand-eel of the variety known as the lesser launce (fig. 1, *b*). The length is 4 inches, and the depth at the gill cover $\frac{1}{2}$ inch. In the figure the head (fig. 1, *c*) has been represented on the same plane as the body of the fish; it really lies on a plane nearly at right angles to it, on what appears to be the upper surface of the liver; an actual sketch would only have shown the under surface of the lower jaw.

The head and about half an inch of the body lie in a groove on the upper surface of the liver; this groove is due merely to the pressure of the eel on the soft tissue of the organ; it is not adherent, nor are there any changes in the surrounding parts similar to those on the other surface.

Passing to the main portion of the sand-eel, we find it adherent throughout to the liver, there is considerable thickening in parts (fig. 1, *d*), of a white colour in the spirited preparation, and merging gradually into the healthy tissue as we trace it outwards, while here and there it appears to bridge over the sand-eel as a distinct membrane. Passing a finger over this white portion, it feels much firmer than ordinary liver, and, if a metal instrument be drawn across it, distinct grating is heard in places, due to a deposition of calcareous matter.

On section through the liver substance and the eel, at right angles to the long axis of the latter at a point *e*, fig. 1, the white membrane before mentioned is seen to pass down and round the fish, separating it completely from the tissue proper of the organ.

A portion from this situation was taken out, and microscopic sections made so as to show the sand-eel in transverse section. Fig. 2 shows the appearance as seen with a magnifying power of 20 diameters. In this figure the line (*a a a*) represents the skin of the eel, while small dots along its inner side show the position and relative size of the pigment cells in transverse section.

Beyond stating that the structure of the eel, as seen by the effect of various staining agents upon its tissues, was slightly if at all affected by its sojourn in this abnormal position, I shall confine any further description to the changes in the capsule of the liver, and to the description of a membrane (fig. 2, *bb'*) closely investing it. The latter membrane is seen to be of variable thickness; taking on stains badly, it shows no definite structure, but is granular, with minute round and highly refractile particles, apparently fatty debris, and here and there the commencement of calcareous transformation. These last conditions can only be made out

with a magnifying power of at least 200 diameters in the thinnest parts of the section.

The capsule of the liver (fig. 2, *cc'*), easily recognised by the trabeculæ passing from it into the substance of the organ, differs from (*bb'*) in not investing more than about two-thirds of the eel, and in its behaviour with the ordinary staining fluids, such as picro-carmin and hæmatoxyline solutions, these latter staining it well. Under a power of 250 diameters the structure is easily made out, consisting of fibrils of connective tissue with the corpuscles, spindle-shaped in section, lying between them. Numerous blood-vessels are present, sending branches into the aforementioned trabeculæ.

I failed to make out the peritoneal coat in the sections examined.

Passing from the healthy portion, we find a considerable increase in the thickness of the capsule, variable in amount, and a decrease in the density of its structure, causing it to resemble young connective tissue.

Fig. 3 is a portion of the capsule (fig. 2, *c'*) magnified 250 diameters, showing what is seen in the thickened parts. It consists of fine connective tissue fibrils (fig. 3, *aa*) separated by round cells, as well as some ovoid and spindle in shape (fig. 3, *b, c*), each containing one rounded or ovoid nucleus, and closely resembling the cells in the inflammations of serous membranes as seen in the human subject.

Blood-vessels (fig. 3, *dd*) are of old formation, while at fig. 3, *e* is a longitudinal section of a newly-formed blood-vessel having a direction at right angles to the general surface of the capsule and of its fibres. In a perfect section of this young blood-vessel it would probably be found to form a loop with its convexity outwards, returning again to the deeper parts of the capsule. The trabeculæ (fig. 3, *ff*) do not seem to participate in the above changes; and, as regards the liver cells (fig. 3, *gg*), it is impossible to say how far the above-mentioned morbid processes may have affected them, owing to want of data as regards their normal histology.

The above-mentioned sections are of great interest, as they point to the very close relation between the changes observed in this case of inflammation, set up by the presence of a foreign substance in a fish, and those which are observed under similar conditions in the human subject. I refer to encysted-parasites, as *Trichina spiralis*, and to foreign inorganic material, as rifle-balls, &c.

In arriving at a conclusion as to the manner in which the sand-eel reached its present situation, and the morbid process going on around it, there are several points worthy of consideration:—

(1) Sand-eels form an article of food to both cod and haddock. Sixty sand-eels have been found in the stomach of a cod dissected by Mr George Brook.

(2) Non-parasitic worms have been found more or less embedded in cod and haddock livers, surrounded by changes resembling macroscopically the specimen in question.

(3) In the dissection of a roe haddock lately made by myself, the following facts may prove of interest, as throwing some light on the seat of the sand-eel, and possibly also on the function of the pyloric cæca in the fish:—

After laying open the stomach and intestine, a small white filament was lying at the commencement of the intestine, and attached at one extremity to the intestinal wall. By making gentle traction on it with a pair of forceps, it became apparent that it was occupying the lumen of one of the pyloric cæca, and on continuing to extract the portion thus withdrawn, it corresponded to the length of the cæcum where it had been, and about

equalled the length of that part just stated to have been lying free in the intestine.

The specimen thus obtained was $\frac{1}{8}$ inch in length, and its greatest diameter $\frac{1}{16}$ inch. Mounted in glycerine and examined microscopically under a power of twenty diameters, the appearance presented was that seen in fig. 4. Notice at fig. 4, *a*, a constriction separating the two nearly equal portions (fig. 4, *b*, and *c*), which are different in appearance; the part (fig. 4, *b*) was that which had lain free in the intestine, and shows the structure of a small worm clearly; the part (fig. 4, *c*) is very granular, but sufficient structure is still visible to identify it as the continuation of fig. 4, *b*; the intervening constriction corresponds with the intestinal opening of the pyloric cæcum, and at fig. 4, *d*, is a part more deeply shaded, which in the specimen is an extravasation of blood in the substance of the worm.

(4) It is necessary to bear in mind the habits of a sand-eel, it being able to pass rapidly from place to place in wet sand, using the finely-pointed lower jaw as a sort of wedge or drill.

From the foregoing it seems probable that the entrance into the abdominal cavity in the case of the sand-eel was from some portion of the alimentary canal, and more especially from the upper part of the tract. The strong coats of the stomach would naturally offer a much greater resistance than the more delicate cæca, with their apertures evidently open to allow the entrance at least of such a fine point as the lower jaw of a sand-eel; and that, having once forced a passage to the blind extremity of such a cæcum, either it should force its way through the end, or that the dilated tube should break off at some point, giving to the passenger a tight-fitting cuirass, and at the same time setting it free in the abdominal cavity, there to die and become encysted, partly by pressure and partly by inflammatory adhesion, in some soft organ, such as the liver.

May not the granular membrane closely investing the sand-eel in the present instance (fig. 2, *b*, *b'*) be a part of such a torn cæcum, which, being cut off from its blood-supply, is rapidly degenerating?

In the examination of the constriction (fig. 4, *d*) the following explanation suggests itself, either the openings to the cæca are protected by circular contractile fibres, which shall prevent the inroad of too much, or that after the cæcum was full, the engorgement of the part by blood, necessarily the case in the process of digestion, should be most marked just at the point where there was the least capability of expansion, and hence the constriction in fig. 4. In neither case would it affect the entrance of the eel; for in the first case it is too weak, and in the latter it would not have had time to appear before rupture had taken place.

In estimating the length of time necessary to produce the appearances around the sand-eel under discussion, the lack of any information as to the rapidity of calcareous degeneration in fish necessitates analogy with the change as observed in the human subject, or animals high in the scale of life, which can at best be little more than conjecture, and therefore tend only to mislead.

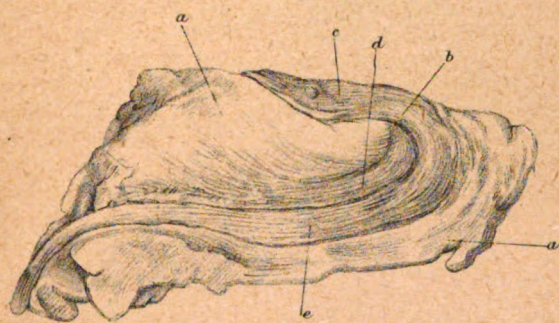
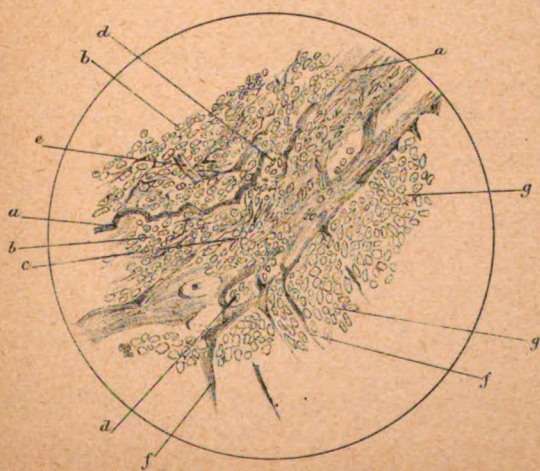
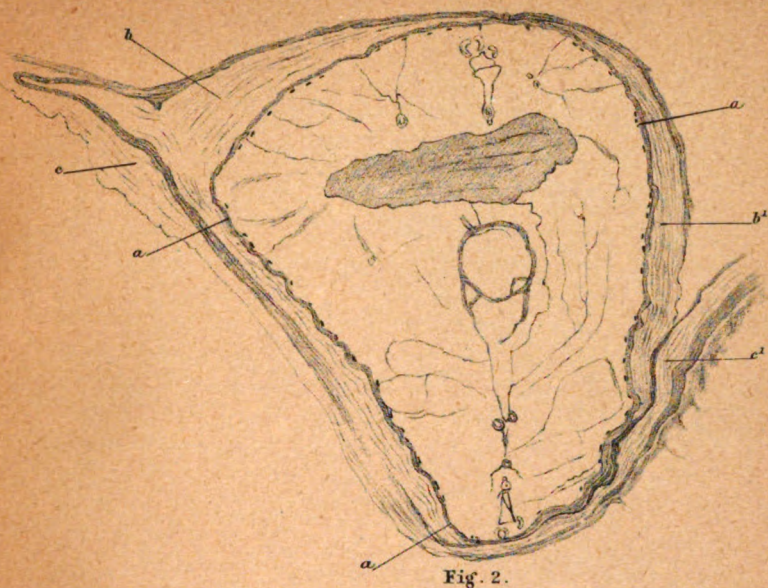


Fig. 1.



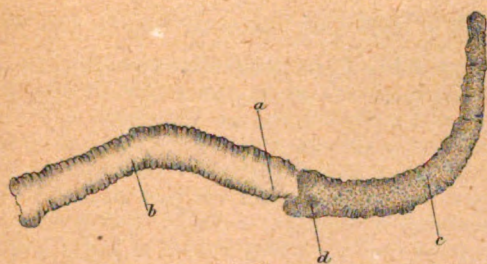


Fig. 4.

APPENDIX F.—No. VI.

NOTES ON METHODS OF EXAMINATION OF RIVER WATER FOR MICRO-ORGANISMS.

The following is a short description of the methods employed in the examination for micro-organisms of samples of water, taken from the Tay and Tweed during the months of March and April. The investigation has been undertaken at the request of the Scientific Investigation Committee of the Fishery Board for Scotland. It is not yet completed, owing to the difficulty experienced in obtaining samples of water, but will be published in full during the course of the year. The work is being carried on in the Pathological Laboratory of the University of Edinburgh, by Mr Joseph Griffiths, under the superintendence of Professor Greenfield.

In describing these methods, it will be well, in order to avoid any confusion, to follow them under three chief headings, viz:—

I. Materials used for cultivation, and their mode of preparation.

II. The manner of obtaining the water, and the information sought regarding it.

III. Methods of cultivation, and subsequent examination.

I. Materials used for Cultivation and their Mode of Preparation.

Of the fluid and semi-fluid cultivating media which were tried, Koch's peptonised beef gelatine was found to be the most successful for the initial cultures. This consists of an infusion of beef, to which a certain quantity of peptone is added, and enough gelatine to make a firm jelly on cooling. It is then carefully neutralised (the exact proportions and methods are not given, as they are those commonly in use, and require much technical description). This is prepared in large quantities, the greatest care being taken to ensure purity. When made it is placed in large flasks, each closed by a cotton-wool plug. These flasks are sterilised (*i.e.*, freed from organisms capable of germinating in the jelly) by repeated heating in a steam chamber. The material thus prepared can be kept for a considerable time, until required for use. Fish and chicken jelly can also be used, but have not been found to serve so well for the present purpose.

For immediate use, small quantities are transferred to test tubes, also closed by cotton-wool. It may be well to describe briefly the method of transferring the gelatine to the test tubes, with a minimum risk of inoculating the gelatine with germs from the surrounding air, which would render it unfit for use.

The test tubes are carefully cleansed with hot water, then allowed to dry as far as possible, by inverting them in the upright position, and drying the exterior with a cloth; then each is supplied with a cotton-wool plug, and as many as possible are placed in a hot-air chamber, heated to a temperature ranging between 160°–170° C., where they remain one hour, after which they are perfectly sterilised. The gelatine, which should, after being kept for about a week, remain perfectly pure and free from any growths, is liquefied in the steam steriliser.

By means of a pipette, previously sterilised in the way to be presently described, ten cubic centimetres of gelatine are placed, with all the necessary precautions, in each test tube. All the tubes are placed conveniently in glass jars, in the upright position, and laid aside until occasion arises for their use. It is always well to keep the test tubes

under observation for some days at least, in order ensure the perfect freedom from organisms.

Of the more solid cultivating media employed, that most used has been bread paste, which is prepared in the following manner:—

Method for Preparing Sterilised Bread Paste.—Take two slices of bread (not fresh), rub together in order to obtain fine bread crumbs, dry again, crumble, and lay aside until required. A little bread crumb is placed in each sterilised flask, until there is a layer at the bottom of nearly half an inch thick, the thickness depending on the size of the flask used, then add sufficient distilled water to moisten the bread crumbs thoroughly. Replace the plug, and subject to the sterilising process in the steam steriliser for half an hour the first day, and for twenty minutes on the two succeeding days, then lay aside until required.

II. *The Manner of obtaining the Water and the Information sought regarding it.*

(a) A hamper is sent out, containing two sterilised bottles, one for surface and the other for bottom water. Each bottle is sterilised in the following way:—It is washed with hot water, rinsed with hot distilled water, then carefully treated with a half per cent. ($\frac{1}{2}\%$) solution of corrosive sublimate in distilled water, and again rinsed out with well-boiled and still boiling distilled water. The stopper, covered with vaseline containing thymol, is placed in the bottle and tied down with string in the ordinary way.

The following printed instructions, showing how to fill the bottles and the precautions necessary, are sent with each hamper:—

‘Do not untie the stopper until you are ready to fill the bottle.

‘No. 1. Weigh the bottle, attach a string to the neck, and a second to the stopper, which should be loosened. Allow the bottle to sink to the bottom, draw out the stopper, allow the bottle to fill, and haul up. Put the stopper in and tie down.

‘No. 2. Fill this bottle with water from near the surface, allowing water to run directly into the bottle. Tie down the stopper.

‘Fill in labels on both bottles. Tie down hamper, and send off at once.’

(b) The labels are printed with the following headings:—‘Date—Name of Stream—Place where Water taken—Sewage—Peat—Chemicals—Any disease (if fish in Stream)—Temperature of Water, and of Air—Mean height of Stream—Height when Water taken—What Rainfall in district supplying Stream?—What Rainfall recently?’

The reverse side is for remarks that the collector may think necessary to make in addition, and for his signature.

III. *Methods of Cultivation and subsequent Examination.*

When the hamper is returned, gelatine and bread paste are inoculated as soon as possible. First a pipette is carefully sterilised by washing with distilled water, afterwards with a half per cent. solution of corrosive sublimate, then with absolute alcohol, and dried in a Bunsen flame. While this is being done, test tubes containing the sterilised gelatine, as many as required, are placed in luke-warm water until the gelatine is liquefied. The stopper of one of the water bottles is untied and withdrawn; a test tube is taken in the left hand, and the plug withdrawn in the usual way; with the sterilised pipette four drops of the water

are transferred to the liquefied gelatine, and the plug is then reinserted in the test tube. After inoculation, each test tube is carefully shaken, care being taken not to allow the gelatine to come in contact with the cotton-wool plug; the tube is then labelled and put aside.

The Gelatine Plate Process.—It is necessary to have a series of bell jars of about 11 inches in diameter, and a corresponding number of large glass plates on which to rest them. Both the jars and plates are carefully cleansed with hot water, and then with a half per cent. solution of corrosive sublimate. A jar is inverted over one of the plates thus treated and kept perfectly level, the plate being covered with a double layer of bibulous paper saturated with a solution of corrosive sublimate, which should be kept constantly moist. In place of these plates, shallow bell jars similarly treated may be used. There are also required numerous small glass plates about 3 inches square. These glass plates, which are to be placed inside the jars, are similarly first washed with hot water, and then with a corrosive sublimate solution. They are afterwards washed in distilled water or absolute alcohol, then placed in the steam steriliser for one hour; they are allowed to cool a little, are taken out and placed under the bell jars, and are now ready for use.

To get the gelatine well spread on the small plates, a tripod with one fixed and two movable legs, which can be lengthened or shortened, to ensure the plate being level, is used. On the tripod a sterilised glass plate is laid, and on it a small glass cover or bell jar.

Under the cover is placed a small plate previously sterilised, on which is poured the gelatine. The method of inoculation has already been described, and here it is sufficient to mention that the inoculated gelatine is allowed to cool until it becomes pretty thick, the test tube is then taken in the right hand, the plug withdrawn, and the glass jar raised to allow the test tube to come fairly under, then pour out the gelatine, and if of the right consistency, it has no tendency to run off the plate, but remains, and forms a uniform layer of about one sixteenth of an inch in thickness.

This process has many advantages, the chief of which is the easy and safe way of obtaining pure secondary cultivations, whereas this is rather a difficulty in the test tube method. There is also a disadvantage which may prove serious, if ample time and attention cannot be paid to the process; it is the tendency of the gelatine to dry, when it becomes a brownish hard scale or crust. To avoid this, it is not only necessary that the whole should be kept in a moderately cool room, but the air in the bell jar should be kept continually saturated with moisture.

The same number of drops of water are added to each bread paste flask. These should also be laid aside for observation. After sufficient water has been taken for cultivation purposes, the reaction and specific gravity are ascertained. All particulars are entered in a ledger on the day of examination.

The test tubes, plates, and flasks are examined daily, and notes taken of any appearances of growth, or changes that existing growths may undergo from day to day. Secondary cultivations are taken from gelatine to bread paste, or *vice versa*, as it may seem necessary to get pure and separate cultivations, aiming at exact and accurate results; for example, if a fungus grows in the gelatine, it is of great advantage to inoculate it on to the bread paste, where it has a good nidus for its development, and sufficient room to extend and flourish; again, bacterial growths on bread paste are transferred to gelatine, to see their mode of growth in, and effect on that medium.

Microscopic examinations, notes, and sketches are made of all the

growths. It is anticipated that, by these means, combined with Dr Angus Smith's hydrogen evolution method and careful microscopic examinations, fairly accurate results may be obtained. So far as the examinations have been carried on, the results have been most satisfactory, the number and varieties of the micro-organisms being determined with ease and apparent exactitude.

APPENDIX F.—No. VII.

NOTE ON CASEOUS TUMOURS FOUND IN THE MUSCLES OF THE
HAKE. BY G. SIMS WOODHEAD, M.D., UNIVERSITY OF EDINBURGH.

In March last Dr Ramsay Traquair placed in my hands portions of the muscle of a large hake, which had been forwarded to him by one of the Fishery Board officers in the North of Scotland. The following Note on the appearances presented on naked eye and microscopic examination was made at the time. I have since confirmed by re-examination most of the observations then made, and have also noted one or two additional facts.

The specimens sent by Dr Traquair consist of small masses of the dorsal and lateral muscles of a large hake. They are preserved in methylated spirit, and for the most part are perfectly bleached. On examining more carefully, it is found that in the centre of the largest piece of muscle there is a dark mass, which, shining through the pale muscle, renders one point considerably darker than the surrounding tissue. On section through the middle of this dark point a cavity half an inch in diameter is found. This is bounded by a narrow zone of fibrous-looking tissue which forms the wall of the cavity and intervenes between it and the surrounding muscular tissue. This zone is translucent and grey without a tinge of the yellow observed in the muscles. Within the cavity and attached apparently only at a single point, is a firm nodular mass of about the consistency of brittle bees' wax. It is much browner than the surrounding tissues, and running through it are deep brown streaks almost like old blood pigment stains. There is no fibrillation of the mass, which breaks down irregularly and has no definite line of fracture.

In some of the smaller pieces of muscle, similar cavities and nodules are seen; they are much smaller; the nodules are not so deeply stained, are attached almost continuously to the walls of the cavity, and are not quite so brittle.

Microscopic Examination.

In the immediate neighbourhood of the wall proper of the cavity, *i.e.*, in the muscle outside the fibrous-looking lining, there are most marked morbid appearances. In place of the normal striated muscle, the fibres appear to have undergone a peculiar vitreous degeneration. In some of these a vitreous material appears at regular intervals along their course, whilst others have become completely transformed into this peculiar material. Wherever this change has occurred the fibres are fractured irregularly, usually at right angles to the longitudinal axis of the muscle. Nearer the cavity still, the muscle fibres are also markedly atrophied; they do not measure more than one-fourth of the diameter of the normal fibres.

Between the atrophied and degenerated fibres in this position there is an increase in the quantity of connective tissue, which is made up of small round or slightly elongated cells, with a few fibrils and older connective tissue corpuscles at intervals. This mixture of atrophied muscles and young connective tissue is gradually lost in what was described under the naked eye as the "zone of fibrous-looking tissue." This zone consists of "granulation tissue," which is composed of young connective tissue, through which are ramifying numerous embryonic blood vessels. A considerable number of these are in the form of loops, the convexity of each loop being turned towards the cavity; others run irregularly and in various directions, and all are distended with blood corpuscles. Although the vessels are relatively less numerous as the cavity is neared, numerous blood corpuscles are found in the cavity; in some instances they form a kind of lining. The large central mass already mentioned is surrounded by a thin zone of young connective tissue cells, with here and there a few blood corpuscles, but no blood vessels can be made out. Within this outer layer is a vitreous-looking mass in which can be seen the remains of fibres of muscular tissue in an advanced stage of degeneration. The individual fibres are enormously swollen; they have lost all trace of striation, but irregular fracture has taken place and fissures are seen running in all directions. On staining with osmic acid a few fat globules are brought into prominence, but these occupy only the spaces at the margins of the fibres, and in some cases the larger fissures. The greater part gives no fatty reaction. With methyl violet there is no waxy or lardaceous reaction, whilst with picro-carmin there is a bright translucent yellow reaction, similar to that given with the horny layer of the skin, but with a slight rosy tinge. Between the swollen, fractured, and degenerated fibres there is an evident increase in the number of connective tissue cells. At no point have I as yet been able to find any parasite, though from the large amount of granulation tissue present at one or two points, I was led to search very carefully for some form of parasitic organism, especially as numerous parasites were found in other positions, as in the submucous tissue of the stomach, the gills, &c.

In the smaller masses above described, the microscopic appearances were very similar to those met with in the larger mass, but here the continuity between the two zones of granulation tissue (*i.e.* that lining the cavity and that surrounding the degenerated muscle mass) is unbroken.

Whatever may be the cause of this peculiar caseation, then, the course of events seems to be as follows.

There is first a degeneration of the muscle fibres, by virtue of which they are entirely deprived of contractile power and elasticity. The muscles surrounding them, still retaining their contractility, draw upon the inelastic mass, and fracture takes place in various directions; eventually the comparatively healthy muscles are divided from the vitreous portions, and a space is left which is gradually filled up by granulation tissue as in a healing wound. This increases in quantity, and at the same time that the muscles near the cavity atrophy fill in the spaces between them. It may be, however, that it is the actual exciting cause of the atrophy. The presence of the dead mass of muscle undoubtedly acts as an irritant, and so brings about the formation of the extremely vascular granulation tissue.

Although I have described the tumours as caseous, it appears that this degeneration of the muscle is rather of the form described by Zenker as the waxy or vitreous degeneration of muscle, one of the forms of coagulative necrosis. According to Zeigler,¹ there is a great tendency to the loss

¹ *Text Book of Pathological Anatomy.* Ziegler. Translated by D. MacAlister. Macmillan & Co., London, 1888.

of striation of the coagulated muscle elements under certain conditions in the human muscle.

He says "under various influences," . . . "as after bruising, forcible extension, raising of the temperature, or febrile disease, the muscle substance is here and there disintegrated, and the contractile myosin coagulates into a lustrous homogeneous mass. This mass breaks up into shining flaky lumps." He further says, "that it is hardly ever quite absent where there has been copious exudation." Such exudation would perhaps account for the vitreous change which is so evidently taking place outside the cavity where the granulation tissue is found between the muscle fibres.

If the mass is of parasitic origin, the irritation and consequent exudation around the parasite would be quite sufficient to account for the whole process.

Another possible explanation is that the coagulative necrosis has been set in during life, after some violent muscular exertion, as most of the masses were found in the muscles which are most frequently and most violently exerted. Here also the subsequent changes would be explicable.

I publish the above Note simply to draw attention to this condition, and in order that I may ask that should similar cases be met with, I may be supplied with some of the material, with which to compare what I have already received. The subject seems well worthy of careful investigation, especially if the disease is of parasitic origin.

APPENDIX F.—No. VIII.

REPORT on the PROGRESS of FISH CULTURE in AMERICA.

By J. COSSAR EWART, M.D., Regius Professor of Natural History in the University of Edinburgh.

Having been instructed by the Board to report as to the methods adopted in America for increasing the fish supply by artificial means, and for gaining a better knowledge of the habits and time of spawning, &c., of food fishes, I sailed for New York on the 3rd of October last, and on arriving (having failed to meet Sheriff Guthrie Smith, who was expected to assist in the inquiry) I proceeded at once to Canada, and reported myself to the Minister of Marine and Fisheries, who was good enough to assist me in every way through his Deputy, Major Tilton, and the Superintendent of Fisheries, Mr Wilmot. After examining the collection of Canadian fish, fishing implements, hatching apparatus, &c. on exhibition in Ottawa, and visiting the Newcastle hatching station, and learning as much as possible of the work done in the various parts of the Dominion, I returned to the United States. On reaching Washington, the British Minister, the Hon. Sackville West, put me in communication with the United States Fish Commissioner, Professor Spencer F. Baird. Through the great courtesy of Professor Spencer Baird, I was able in the comparatively short time at my disposal to study the various methods adopted for carrying on the work of the Fish Commission, and to visit the principal hatching stations (with the exception of the one on the McCloud River in California), and also the great fishing centres and the various establishments for receiving and preserving fish, and for utilising the bye-products of the fisheries.

In Canada I was especially interested in the collection of food fishes and of fishing appliances which were being exhibited in Ottawa, and with the simple arrangements adopted at the Newcastle and other hatching stations for the artificial cultivation of salmon and white fish. When examining the valuable collection of fish, &c., it occurred to me that we ought to follow the example of Canada, and form a collection of our food fishes, fishing appliances, and fish-hatching apparatus, to which might be added, as opportunity offered, specimens illustrating the food and enemies of the useful fishes, and also specimens of eggs and of young fish at various stages of growth. On the other hand, it occurred to me when considering the arrangements in Canada for superintending and developing the Fisheries, that the Dominion Government might with great advantage institute an independent Fishery Board similar to our own, which would be responsible to Parliament for all matters connected with the fishery industry.

At present the Canadian fisheries are worth about $3\frac{1}{2}$ million pounds sterling annually, a little more than the value of the Scottish fisheries, but without much difficulty this amount might be greatly increased. It is to the credit of the Canadian Government that a sum of about £40,000 is voted for the better development of the fisheries. Part of this sum is devoted to supporting eleven stations for the hatching of salmon and other freshwater fish, while the remainder is given away as bounties.

Great benefits might accrue if part of the £40,000 were devoted, under a proper authority, to gaining some information as to the nature of the principal fishing banks along the coast, and of the habits, food, &c., of the useful fishes which frequent them.

On reaching Washington I was much impressed with the great development which the Fish Commission had already reached. I found in addition to the office of the Commission, in which a large staff is constantly engaged, that there was in Washington (1) a large central station, where hatching operations were carried on on a large scale, and through which many millions of fish pass annually on their way to the various states; (2) extensive ponds devoted to carp culture; (3) an excellent collection, in the National Museum, of food fishes, fishing implements, and of the apparatus used for dredging, sounding, and other operations; (4) several rooms in the Smithsonian Institution, in which the scientific staff of the Commission was engaged in studying the structure and development of fish and other forms, and preparing careful drawings and preparations of all the more important fish found in the American waters. Further, at the Navy Yard in the vicinity of Washington, I had the opportunity of seeing the 'Fish Hawk,' which has been of great use for dredging and other work, and on which numerous hatching experiments have been made with the eggs of the shad and other fish, and what was even more instructive, of examining the 'Albatross,' a twin-screw steamer of a thousand tons, recently constructed for the work of the Commission, and manned with officers of the United States' navy, specially trained for carrying on the dredging, sounding, and other operations of a like nature, considered requisite by the Commissioner of Fisheries. At Wood's Holl I had an opportunity of seeing the large building recently constructed to serve as the centre of the Commission during the summer and autumn, and the adjoining sea ponds, and the marine laboratory which, when completed, will afford better facilities for studying the life history, development, &c., of fish and other marine forms than anywhere else exist.

At Newhaven Professor Verrill showed me some of the numerous specimens collected by the 'Fish Hawk' and 'Albatross,' and explained

all the arrangements that had been adopted for their examination and distribution.

The methods adopted for the hatching of salmon and trout, I had an opportunity of studying at Bucksport and Cold Spring, while the appliances used for shad and fresh-water herring were available for examination in the Central Station, Washington, as were also the cars, by means of which carp, young shad, &c., are carried all over the States. When at Boston I had the opportunity of seeing the various boats and nets and other gear in use amongst the United States fishermen, and of examining amongst other things the packing houses from which the fresh fish are despatched (carefully packed in ice) to the adjacent towns, and also a large ice-house where fresh fish are kept in a frozen state for months at a time.

While at Gloucester the various methods of preserving cod and other fish were explained to me, and I had an opportunity of observing how carefully the refuse is utilised for the preparation of oils, glues, fertilizing agents, &c., and learned that it realised about 14 per cent. of the total value of the United States Fisheries. I need only mention further that, through the kindness of Mr Blackford, I was initiated into the mysteries of the New York Fish Market, that I saw the floating cars in which cod and other fish are kept alive, and the ice stores in which fresh salmon, mackerel, &c. are preserved until wanted.

On inquiring as to the origin of the United States Fish Commission I learned that those interested in the American fisheries, believing that the food fishes on the eastern coast of the United States were diminishing in number, appealed some years ago to the Central Government to institute an inquiry with a view to ascertaining, if possible, the causes of the alleged decrease, and suggesting a practical remedy. As a result of numerous appeals, the President was directed by Congress in 1871 to appoint a Commission of Fish and Fisheries, and the heads of the Executive Department of the Government were instructed at the same time to render such assistance in carrying out the inquiry as lay in their power. Professor Spencer Baird was appointed Commissioner, and was instructed 'to prosecute investigations on the subject (of the diminution of the valuable fishes), with the view of ascertaining whether any and what diminution in the number of food fishes of the coasts and the lakes of the United States was taking place, and if so, to what causes the same is due; and also whether any and what protection, prohibitory or precautionary measures, should be adopted in the premises, and to report upon the same to Congress.'

The work undertaken by the Commission since its institution might be arranged under three separate headings—

- (1) The systematic investigation of the waters of the United States, and the biological and physical problems which they present.
- (2) The investigation of the methods of fisheries past and present, and the statistics of production and commerce of fishery products.
- (3) The introduction and multiplication of useful food fishes throughout the country.

It seems that in comparatively recent times the waters off the coast of New England abounded with cod and other fish to such an extent that a large supply could be taken throughout almost the entire year along the banks, especially in the vicinity of the mouths of large rivers. At the same time it is alleged that the tidal streams were almost choked up with the alewives, shad, and salmon that were struggling for entrance in the spring, and which filled the adjacent waters throughout a great part of the year. By erecting impassable dams across the streams, the salmon, shad,

and fresh-water herring were prevented reaching their natural spawning grounds, and the result was that these anadromous fish rapidly began to diminish in numbers, and in some localities to disappear altogether; and with their disappearance the value of the fresh-water fisheries so greatly diminished in value that they no longer paid the working expenses. Not only were the salmon, shad, and fresh water herring fisheries all but completely sacrificed to the great lumbering and manufacturing interests, but, as the runs of young salmon and the myriads of shad and fresh-water herring disappeared from the in-shore waters, the cod, pollack, haddock, mackerel, and other sea fish, that annually approached the coast, also became more and more scarce.

Of the relationship between the presence of fish such as shad and fresh-water herring in the bays and estuaries, and the abundance of cod, haddock, and other sea fish in the in-shore ground, there seems no doubt whatever. The United States Commissioner of Fisheries reported some years ago that 'as the river fisheries have been depreciated or destroyed 'by means of dams or by exhaustive fishing, the cod-fish have disappeared 'in equal ratio;' that the cod and other in-shore fisheries having become practically a failure was due to the disappearance primarily of the fresh-water herring, and, secondarily, of shad and salmon, more than to any other cause. The old fishermen of Eastport, in Maine, remember when cod were taken in abundance off their shores, while now only stragglers are caught, and this holds good for nearly all other parts of the New England coast north of Cape Cod.

Some forty years ago, in Seal Cove Creek, which discharges to the east of the southern extremity of Grand Manan, cod, haddock, and pollack, and even halibut were taken in great abundance while feeding on their favourite and easily captured fresh-water herring. In course of time a dam was built across the river in which the fresh-water herring were wont to spawn; and not only did the fresh-water herring disappear, but the cod and haddock and other sea fish so greatly diminished in numbers, that the fishermen found it necessary to search for new fishing grounds elsewhere.

In the case of America, we have abundant evidence of the existence of an immense number of salmon and trout in the rivers and lakes. Dr Hamlin, writing in 1869, says—'A century ago the rivers and lakes of 'Maine teemed with the salmon and the trout. Not only were the great 'rivers and expanded lakes frequented by these valuable fish, but even 'the lesser streams that emptied directly into the sea or its fiords, and the 'most distant tributaries that drained the wide forests and mountain 'ranges of the interior, were stocked with incredible numbers of the Salmonidæ. Since this time a great change has taken place, and while 'casting our fly to-day in our exhausted streams, we can hardly believe 'the stories of our octogenarian fishermen relative to the vast shoals of fish 'they encountered when boys, or the still earlier accounts of the Jesuit 'fathers when they visited our primitive forests and attempted to found '“La Nouvelle France.”' He adds—'This almost complete extinction of 'the noblest fishes in the State is not the result of the workings of natural 'law, but due entirely to causes within the power of man.'

In former times there were twenty-eight rivers flowing through the United States towards the Atlantic in which salmon were abundant; but at the present time there are only eight in which salmon are now regularly found. The disappearance of salmon from the American rivers has resulted partly from the building of dams and partly from excessive fishing—the dams held the fish in check while the fishermen caught them—the extermination being often effected in a remarkably short period. Even in the great lakes the white fish (*Coregonus albus*) and the trout

(*Salmo salvelinus*) have been decreasing rapidly during recent years; in some districts only half as many are taken now as were captured ten years ago. Apparently this may be accounted for in some cases by the use of small-meshed nets; while in others it seems to have resulted from the diminution of the streams running into the lakes, owing to the cutting down of the forests by the lumbermen.

On inquiring as to the attempts made to increase the fish supply by artificial means I learned that soon after the Fish Commission was instituted experiments were made in hatching shad (*Alosa sapidissima*). The shad is one of the most important of the American food fishes. It is a member of the herring family, but differs from our herring in being considerably larger, and in spending a part of each year in fresh water, where, like the salmon, it deposits its spawn.

There are two species of shad in our own waters, the allis-shad (*Clupea alosa*) and the twait-shad (*Clupea finta*). The allis-shad is more abundant on the English than along the Scottish coast, but occasionally specimens are taken by our fishermen, which are usually looked upon as large herring.

The American shad ascend the rivers during the winter to spawn, and they return again to the sea in spring. Like the salmon, they seek their birthplace; but their movements are greatly influenced by the temperature of the water,—60° Fahr. being the temperature they apparently prefer.

Sometimes when, on entering their ancestral stream, they find the water too warm, they return again to the sea and steer northwards until suitable water is reached. They are found from the St Johns, in Florida, as far north as the St Lawrence. They begin to ascend the St Johns about the end of November and return about the end of April, the young following them early in May, when they are often nearly three inches in length.

In early times all the rivers between the St Lawrence and the St Johns were invaded annually by immense shoals of shad. The early settlers used to capture them by dip-nets, sometimes by gill-nets. Long before roads were made, the farmers used to make a yearly pilgrimage to the St Johns and other rivers to secure a supply of shad. Having captured and preserved as many fish as they required for the year, they swung the well-filled sacks over their pack horses, and found their way back again through the forests to settle down to their usual farm work. But in course of time the lumber-men appeared on the scene, and began an unequal battle with the shad. They built impassable dams, and polluted the rivers with sawdust and other refuse, and otherwise, unconsciously no doubt, but usually with striking success, did their best to exterminate the shad. The result was that, along the Atlantic coast, the rivers which once teemed with shad and other fish were so completely exhausted that, when artificial culture was begun in 1867, it was sometimes impossible to obtain enough fish to carry on the work; this was especially the case with the Savannah and the rivers north of the Potomac. The history of all the rivers is practically the same. The Potomac, for example, used to be almost choked with shad once a year ascending to the upper waters to spawn, but, partly owing to the construction of dams and partly owing to over-fishing, nearly all the shad were destroyed. So few were left that the numbers taken no longer paid the working expenses of the fishermen. During the four years of the war a remarkable increase took place, and large takes were obtained for some years after peace was declared; but again a steady decline set in, and would have continued until the river was exhausted, had not fish-culture come to assist Nature in her unequal struggle with the destructive engines of the nineteenth century. By introducing from one to ten million fry annually since 1873, the catch

in the Potomac has not only been maintained but considerably increased, there being a rise of nearly 1,000,000 lbs. since 1877. It is admitted that, notwithstanding the constant fishing, shad are more abundant now along the Atlantic coast than they were some years ago, and that, had it not been for the 200,000,000 shad which the Commission had hatched since it was instituted, many of the rivers would ere this have been quite exhausted. The shad are now hatched at four different centres. Large numbers are hatched at the Navy Yard, and at the Central Hatching Station, Washington, while others are hatched at Avoca and Havre de Grace. At all these stations the work of hatching is now carried on in practically the same way. The Central Station is the most complete and extensive. There 20,000,000 shad can be hatched at one time, and as many as 900,000,000 might be turned out in a single season. The shad eggs are small and semi-buoyant, and as many as 250,000 may be obtained from a single fish. Arrangements have been made with the shad fishermen in the creeks and bays along the Potomac and other rivers by which the majority of the ripe eggs are taken from the fish caught in their seines and forwarded to the hatching stations. The fertilised eggs are arranged in trays, which are piled and then strapped together between two frames to form a sort of crate. On arriving at the station they are at once introduced into glass hatching jars, which are about 20 inches in height and 9 inches in diameter. Each jar can accommodate from 15,000 to 18,000 eggs. When charged, the jars are placed on tables and connected with the water supply. When this has been done, further attention is seldom required, for the jars have been designed so that the dead eggs escape with the out-flowing current—each jar being, as it were, a self-picker.

In four or five days the development is all but complete, and then, by way of preparing for the young brood, the jars are arranged in groups around a large glass basin which serves as a receptacle for the fry.

From these receptacles the fry, which are about three-eighths of an inch in length, are introduced into large tin cans, each capable of holding about 10 gallons of water, and of carrying from 10,000 to 40,000 young fish—the number varying with the time required for their transit. The fry have been found to survive best when introduced into the river some 200 miles above the point where the fresh and salt water meet. They remain all summer in the river, but when the temperature falls to about 60° in the autumn they find their way down to the estuaries, and then they venture into the sea, but they never seem to proceed far from the shore. At the end of the third year they ascend the river to spawn, always apparently selecting the river from which they first reached the sea, and only turning away from it when the temperature is unsuitable.

The distribution of the shad is now effected by means of specially-constructed cars, which at first sight look somewhat like sleeping-cars. The car labelled "Baltimore and Ohio" is nearly 60 feet in length. It has a width of 10 feet and a height of 14 feet, and it cost about £1600. This car has two refrigerator-chambers, each 34 feet in length and 34 inches wide, and 26 inches high, so as to accommodate easily the tin cans containing the fish. In connection with these chambers there are four large ice-boxes which serve to maintain an equable temperature (about 50° Fah.), and there are arrangements for a continuous circulation of aerated water passing in and out of the fish cans. In addition, there are all the appliances required for the attendants, who are often living constantly "on board" for months at a time.

By means of these cars, shad, carp, and other fish are carried all over the American continent. In 1883 one of the cars, in distributing shad, carp, and salmon, travelled over 30,000 miles.

One of the most interesting experiments ever made with fish was the transporting of shad right across the American continent to introduce them into the Pacific. This was successfully done by Mr Livingstone Stone, who introduced some 35,000 young shad into the Sacramento River on the 2nd of July 1873. From this small beginning mighty results have followed, for at the present day not only are shad found in the Sacramento, but they have already extended their range some two thousand miles along the Pacific coast—so thoroughly have they made themselves at home in the Pacific Ocean and the rivers which enter it from the American continent. Not only are stragglers found in the various rivers, but they are already so abundant that they now take no mean place amongst the food fishes in the Californian and other markets. The prices paid for shad are now quoted in the western papers as if they had existed on the Pacific coast since the beginning of time.

Another fish of considerable importance to which the United States Fish Commission has recently devoted its attention is the alewife or fresh-water herring (*Clupea vernalis*). The alewife, like the shad, frequents for one part of the year the estuaries and the in-shore ground along the coast from the Southern States to the St Lawrence (where it is known as the gaspereau), while it spends the other part of the year in the rivers or lakes in which it deposits its spawn. Those who have been in the vicinity of the Potomac know how excellent a food-fish the alewife is, surpassing in some respects our delicious North Sea herring, and being generally considerably larger. In early times the alewife used to ascend the rivers on the Atlantic coast in immense shoals, but now they are comparatively rare. The catch in the Potomac in 1833 has been estimated at 750,000,000 fish, while at the present time it does not exceed 5,000,000. Not only is the alewife valuable as an article of food for man, but it is also extremely valuable as food for salmon and trout, both in ponds, lakes, and rivers, and it is even more valuable still as food for cod, haddock, mackerel, and other deep sea fish. In several instances full-grown alewives have been introduced into new waters, and a sufficient number of experiments have been made in hatching the eggs to show that the alewife can be manipulated as easily as the shad. The eggs are smaller than those of the shad, and they hatch more rapidly. Unlike the sea herring, the eggs are non-adhesive, and being slightly buoyant, they can be readily hatched in the same apparatus as those of the shad. Recently 2,000,000 were hatched at the Navy Yard, Washington, and distributed through the Central Station. In a short time the hatching of alewives may become as important a branch of the Fish Commission work as the hatching of shad is now.

But not only has the United States Fish Commission directed its attention to increasing the shad and fresh-water herring, it has attempted to naturalise the cod to the in-shore waters, by artificial means.

The cod has long been and still is the most important of American food fishes. It is said that the emigrants who formed the first American colony at Jamestown were enabled to survive and consolidate themselves into a permanent community by devoting themselves in great part to the capture of cod off the New England shores. At that time the waters abounded in cod and other fish to such an extent that large supplies could be obtained throughout almost the whole year. The fishing about Cape Cod at the beginning of the seventeenth century was said to be better than at the great Newfoundland banks. Captain Smith, the pioneer of the American fishermen, recognised that in the New England waters he had reached the Eldorado of fishermen; and, being a practical man, in referring to his success wrote—'And is it not pretty sport to haul up two-pence, six-pence, and

'twelve-pence as fast as you can hale and veare a line? He is a very bad 'fisher that cannot kill in one day one, two, or three hundred cods.' In 1614, Captain Smith's vessel captured 47,000 fish off the coast of Maine. Accounts of the success of Captain Smith and others, having reached Europe, the pilgrim fathers were all the more readily induced to turn their eyes westwards, and to appeal to King James that they might be allowed to settle in America. When asked what profit would arise, they answered, 'Fishing.' To which His Majesty replied, 'So God have my soul; 'tis an honest trade; 'twas the apostles' own calling.'

So successful were these early settlers, that in 1624 they sent home to old England a ship load of fish cured with salt of their own making, and before the end of the century they were annually exporting dried cod-fish to the south of Europe to the value of 400,000 dollars.

The old fishermen at Eastport and other fishing centres remember well when cod were abundant along their shores, when they even entered the estuaries and bays, when, in fact, fishing was a comparatively easy occupation. At the present time only stragglers are met with in-shore, and the fishermen have to brave the dangers of the Atlantic in search of the cod shoals.

The first experiment in hatching cod was made in 1878. Some millions of cod were hatched and turned into Gloucester harbour. In the following year numerous young of the deep-sea 'silver grey cod' were found in the vicinity of the harbour. In the following winters they were fairly abundant, and in 1882 some taken by boys fishing from the wharves were 14 inches in length. In 1883 sometimes a hundred young deep-sea cod (the largest weighing about five lbs.) were captured by the fishermen when in search of bait, and there were still a few remaining last winter. The Gloucester fishermen say they never saw a shoal of deep-sea cod in the harbour before, and they all believe that those recently taken during several consecutive winters had developed from the fry introduced by the Fish Commission.

The apparatus for hatching cod on a large scale at a small cost has not yet been perfected. When this has been done it will then be possible to ascertain whether local colonies of cod can be established around our coast.

I have already indicated that in early times the rivers and streams on the Atlantic side of the American continent teemed with salmon. Recent inquiries have proved, however, that in the greater number of these rivers the salmon have been all but exterminated, while in the others their numbers have been greatly diminished. The result is that at the present day the Eastern Salmon Fishery is only worth about £5000, a small sum compared with the Pacific Salmon Fishery, which yields over £600,000, or with our Scotch rivers, which yielded in 1883 £350,000, while the Canadian rivers yield about £300,000. The work of re-stocking the salmon rivers on the Atlantic coast was initiated in 1864. Until 1871 eggs were chiefly purchased from Canada; but in that year a hatching station was established on the Penobscot, the only river in the United States that had succeeded in retaining any number of the Atlantic salmon. During 1871 over 70,000 eggs were collected, and in due time distributed, chiefly to the rivers of Maine, Massachusetts, and Connecticut. Since 1871 the work of hatching has been greatly extended. With the aid of a subsidy from the Fish Commission, between two and three millions of eggs are now manipulated every year, and distributed to the rivers of the various Eastern States.

The salmon fisheries of Canada are far more valuable than those of the Eastern States of the Union, being, as already mentioned, worth about

£300,000 annually. By way of maintaining and, if possible, increasing their commercial value, large sums are spent on artificial propagation. In the spring of 1883 over five and a half millions of young salmon were distributed to the various rivers, and in the autumn of the same year over eight and a half million eggs were laid down in the eleven Dominion hatcheries under the care of the Superintendent of Fisheries. Both at the United States and the Canadian hatcheries the apparatus in use is extremely simple. The eggs, when fertilised, are deposited on wire trays, which, when necessary, can be arranged in tiers one above the other. In this way there is great economy of space, and large results are obtained at a minimum expenditure. This method is said to be quite satisfactory; but it seems that enough time has not yet elapsed to admit of an accurate estimate being made as to the results of the hatching operations that have been carried on either in Canada or the United States with the Atlantic salmon.

If, however, we turn from the operations on the Atlantic coast to those carried on by Mr Livingstone Stone on the M'Cloud river in California, we find very definite results indeed.

The Pacific salmon differs somewhat from our own; but it reaches a large size, and is said to be quite as delicious when it appears on the table. It differs chiefly from our salmon in being able to survive in comparatively high temperatures. While the Atlantic salmon can only survive in a temperature of about 60°, the Pacific salmon is quite vigorous when the thermometer stands at 100°, and it has been known to spawn in water with a temperature of 75°. This being the case, attempts are being made to introduce the Californian salmon into the rivers of the Southern States. Another important point of difference is that the development is more rapid, and the fry on hatching are more hardy than those of the Atlantic salmon. From the information available, it seems that the yield of the M'Cloud river for some years previous to 1875 was about 5,000,000 lbs. By introducing 500,000 fry in 1873 and 1874, the take was increased to nearly 6,500,000 lbs. in 1877 and 1878. In 1875 nearly a million fry were introduced; in 1876 1½ million fry were introduced; and in 1877 and each of the following years up to 1881 over 2 million fry on an average were introduced; and, as a result of this, the take in 1880 reached the enormous maximum of 10,837,000 lbs., more than double that of 1875, while the average since has been over 9½ million lbs.

The M'Cloud river is usually given as an example of what can be done under favourable circumstances by artificial means. The river had never been exhausted, and the obstructions and pollutions found in most of the rivers of the eastern shore did not exist. The M'Cloud river is also quoted as illustrating the commercial importance of fish culture. The cost of hatching and planting 2½ million fry is estimated at £750. The value of the increase in the take say for 1881 was nearly £65,000, leaving a net increase of £64,250.

From what has been said when referring to the eastern rivers, it will be evident that an important step in restoring them to their pristine condition will be in removing the dams, or, doing the next best thing, constructing fish-ways that will enable salmon as well as shad and alewives to reach their original spawning grounds. The necessity for fish-ways has long been recognised, but apparently it has been left to Colonel M'Donald of the United States Fish Commission to devise a good fish-way. The M'Donald fish-way is peculiar in having a fairly strong upward current which assists the fish to ascend. In a large working model in the Central Station, Washington, the upward current is well illustrated, for when a small boat

is placed at the bottom of the ladder, it slowly ascends until it at last reaches and remains at the summit. This M'Donald ladder may have a great influence on the future of the salmon fisheries.

A considerable amount of work has been done in hatching and rearing trout, and in transporting them from one part of the continent to another; but although excellent results have been obtained, especially with the California trout (*Salmo irideus*), trout culture can scarcely be looked upon as of national importance.

Just as the rivers became exhausted as the white man extended his sway, so have the lakes suffered. There is no lack of evidence of the existence of immense numbers of salmon, trout, and whitefish in the inland waters for years after America was colonised by Europeans.

The Atlantic salmon used to be plentiful in Lake Ontario and Lake Champlain, but now they are only found on the Canadian side of Lake Ontario, and there probably because of the fry introduced from the Dominion hatchery at Newcastle. In addition to the Atlantic salmon there is another known as the land-locked salmon, which seems to be a variety of *Salmo salar*, only differing from it in that it never or seldom finds its way to the sea,—its never reaching the sea, where there is abundance of food, may account for its weight only averaging 5 or 6 lbs. Many millions of the land-locked salmon have been hatched and introduced into the great lakes. Another familiar denizen of the lakes is the whitefish (*Coregonus albus*), which is also a member of the salmon family. It is an excellent food-fish, which is easily captured throughout the whole year, and, having a large number of eggs, it can be readily multiplied artificially. A 2 lb. fish has as many as 20,000 eggs, while a 7 lb. fish has as many as 66,000. The fry, when hatched, simply require to be turned into the lake, so that there is no obstacle to this fish being multiplied to an almost unlimited extent. Being commercially of great importance, having a wide distribution, and, unlike most other forms, feeding entirely on crustacea and other invertebrates, it has, since 1872, received considerable attention from the Fish Commission. A special hatchery has been established at Alpena capable of hatching 100,000,000 eggs at one time. During the spawning time, the fish are penned until all the eggs each produces have been obtained. In 1882, 32,000,000 fry were sent from Alpena, and 16,000,000 from Northville to the great lakes, while others were distributed to various parts of the country. Over 37,000,000 whitefish were distributed from the Dominion hatcheries in 1883, and during the present year about 225,000,000 young whitefish will be introduced into the great lakes of the United States. As the result of the hatching of immense numbers, the take of fish, which before the hatching began had diminished 50 per cent. in ten years, is now on the increase. The fishermen fully recognise the importance of the hatching operations, and, in fact, they freely admit that, but for the timely interference of the Fish Commission, they would have been compelled to abandon this important fishery altogether. The eggs of the whitefish, unlike those of the salmon, are small and adhesive; they are deposited in a shallow nest formed in the sand or gravel by the female, and the hatching does not take place until about one hundred days after they are shed. The development extending over a long period, has allowed the whitefish to be successfully transported to France, Germany, and Tasmania.

It is impossible to refer to all the work of the United States Fish Commission, but reference must be made to the introduction and distribution of the German carp. For centuries the carp has existed in the rivers of Europe, and, since the beginning of the thirteenth century, if not from an earlier date, it has been carefully cultivated in artificial ponds. The monks of the Middle

Ages devoted much care to carp culture, both on the Continent and in England; and although the carp is now feral in England, it is still under domestication in Austria and Germany. For long it has been under the patronage of princes and emperors, and at the present day Prince Schwarzenberg is the largest breeder of carp in Europe, his ponds yielding about 500,000 lbs. per annum. In Hanover, Holstein, and other principalities, there are numerous carp ponds, almost every large farm having at least one. In India and China the carp is extensively cultivated, and it has been found to be one of the most suitable fishes for cultivation, partly owing to its easy adaptability to all waters,—rivers, lakes, and ponds, and even estuaries,—its rapid growth, and its great frugality in regard to food. When $2\frac{1}{2}$ years old, it weighs on an average $3\frac{1}{2}$ lbs., but being a long-lived fish, it may reach a length of several feet and weigh from 30 to 40 lbs.: and if the records of monasteries and of old families are to be trusted, carp have sometimes been taken which were from 70 to 90 lbs. in weight.

In May 1877, the Fish Commission imported a number of German carp, and placed them under the care of an experienced keeper, Rudolph Hessel, in specially constructed ponds in Washington. Through the devotion of Hessel the carp have enormously increased, and, what is even of greater importance, considerably improved since their introduction into the New World. So much improvement has in fact taken place since the carp was introduced into America that there is now a considerable demand for American carp in Germany.

When a sufficient number had been reared at Washington to serve as stock, it was intimated by the Fish Commission that carp might be had, delivered free of expense anywhere throughout the States, on application being made through a member of Congress.

In 1879 over 6000 were distributed to 573 applicants residing in 24 different states. In 1880, 31,400 to 1374 applicants scattered over 34 states. In 1881, 160,000 were distributed to nearly 6000 applicants, representing over 1200 counties and 48 states. In 1882 there were 10,000 applications for carp, and about 200,000 fish were required to meet the demand. In distributing them the fish cars covered over 34,000 miles. Already carp have been planted in 30,000 separate pieces of water, which in the aggregate represent 100,000 acres. The ponds are scattered over the States, and in most instances they have been formed in waste land which yielded no returns. Since its conversion into ponds this land now yields 20,000,000 lbs. of carp, worth nearly £200,000 sterling.

There is another fishery in which we are all interested,—viz., the oyster fishery. Unfortunately the history of our oysters is a sad one to relate. The Forth once yielded its tens of thousands; now it can scarcely be said to yield its hundreds, the value of last year's crop being under £500. Altogether our waters only succeeded last year in supplying oysters to the value of £2200. Compare this with the yield of the New England shores. In 1880 over 22 million bushels of oysters were taken, about 80 per cent. coming from the Chesapeake Bay. They were worth over $2\frac{1}{2}$ million pounds sterling.

What can be done to increase our supply of British oysters? Artificial culture has been a failure in England; but, on the other hand, in Holland, where the breeding ground has been protected, artificial culture of a limited kind has been an entire success; the value of one small area not exceeding 8000 acres has risen from £1700 in 1870 to £28,000 in 1885. Our oyster beds are under the control of the Board of Trade, but its regulations are not well suited to promote their development. If British oysters are no longer capable of flourishing in British waters,

as some seem to think, let us by all means set about introducing others from America or Portugal, or any other country capable of providing good stock. At the outset we cannot do better than apply for a consignment from some part of the New England coast or from Canada, where the conditions as far as possible resemble those in our own firths and bays.

The American Fish Commission has succeeded in hatching oysters from artificially-fertilised eggs; but this success has not yet led to any important results. What we want are numerous nurseries where the young can be reared and afterwards sown on the natural beds. These nurseries must assume the form of ponds, into which an abundant supply of food is either naturally or artificially introduced for the young oysters.

That the United States Fish Commission has been remarkably successful since its institution is universally admitted, and the success is justly attributed to the devotion, energy, and scientific zeal of Professor Spencer Baird, the Fishery Commissioner. It should, however, be remembered that ample funds and appliances of every kind have been provided by the United States Government, and that the various State Departments have given great assistance to the Fish Commission.

Since the work began in 1871 until 1883, 1,190,955 dollars were appropriated by Congress for the Fish Commission, and, in addition, 1,101,096 dollars have been voted from 1866 to 1882 by various States, these two sums representing roughly £450,000. During the year 1882-1883, the appropriation for the work of the Fish Commission amounted to about £30,000, exclusive of votes for vessels and a railroad car—£23,000 of this sum being for propagation, and about £6000 for ponds and hatcheries. In 1882 the State Fish Commissions voted about £24,000, which, with the £30,000, gives the total of £54,000 devoted by the United States for increasing their fish supply in one year. If to this were added the sum of £5400 voted by the Dominion of Canada for fish hatching, we have the grand total of £60,000 for the North American continent. It is only right to remark here that very much smaller sums than those provided by the science-loving United States Government would suffice for carrying on the work of investigation and hatching in this country. Neither the upper nor the lower proprietors of our rivers can expect public money to be spent on hatching salmon; and our coasts being limited, if a few thousands were voted annually for hatching and other work, many hundreds of millions of young fish could be introduced into our territorial waters.

In addition to the large annual vote, the Fish Commission has several hatching stations, a marine laboratory with sea ponds and all the other requisites attached for hatching and other work; a large steam vessel constructed for dredging and surveying operations, and a smaller steam vessel adapted for inshore work. These vessels are provided with all the most recent appliances for sounding and other operations, and they are in charge of officers of the U.S. Navy, who are capable of making accurate observations, as to temperature, depth, &c. This work has been facilitated not only by the selecting officers with a real interest in scientific work, but also by placing the various vessels at the entire disposal of the Fish Commission.

In referring to the work of the United States Fish Commission, one ought to refer to the valuable reports it has presented to Congress. In addition to many valuable original papers, the Reports contain almost everything of real value that has ever been written on the subject of the fisheries and fish culture.

From this short and necessarily imperfect statement, it will be evident that fish culture as practised in the United States means something more than the hatching of fish; it, in fact, aims at gaining 'a thorough

'knowledge of the life-history from beginning to end of every species of economic value, the history of the animals and plants on which they feed, or upon which their food is nourished; the history of their enemies, as well as a knowledge of the currents, temperatures, and other physical phenomena of the waters in relation to migration, reproduction, and growth.'

From the experience already gained in America it is evident that fish culture can only be useful when conducted on a large scale. In speaking of fish culture, I do not refer only to trout and salmon; in fact, I rather, for very obvious reasons, eliminate these, and refer especially to the cultivation of the estuaries and bays and territorial waters generally, which belong, as it were, to the people at large, and not to private individuals. Hence this fish culture, if undertaken at all, must be carried on at the public expense, through one of the Government departments. It is too much to expect that private individuals, or even companies, will devote large sums annually to studying the habits and life history of the inhabitants of our seas, or even to hatching hundreds of millions of cod, haddock, turbot, and other food fishes, or to introducing new fish from America and elsewhere. Even although several of the Eastern States of America combined together to improve their fisheries, no satisfactory results were obtained until the Central Government entered the field and instituted inquiries on a thoroughly scientific basis.

Nature has done her best in multiplying to an enormous extent the eggs of our food fishes, providing the cod, the haddock, the turbot, the flounder, with millions of eggs, while the salmon, the herring, and many others have their thousands. But in doing this Nature, who never makes mistakes, has confessed her inability to fertilise or hatch even a small percentage of the eggs produced, probably not one cod egg in a thousand is fertilised, and only very few of the fry produced ever reach maturity. Man by stepping in might easily fertilise and hatch 90 per cent. of the eggs, and he might afterwards protect for a time the young fry before turning them adrift into the world of waters.

Although fish culture in its broad sense, as understood in America, does not yet exist in Britain, it is well known that the cultivation of salmon and trout has been extensively practised both in England and Scotland for many years. At the Howietoun Fishery, for example, where salmon culture has reached a higher state of perfection than anywhere else in Europe or America, 99 per cent. of the eggs are successfully hatched, and almost as large a percentage of the fry reared; in fact, all the difficulties of fertilising and hatching the eggs, and what is of far greater importance, all the difficulties of feeding and rearing the fry, have been overcome.

What has been done for the salmon and trout now requires to be done for our sea fishes. It can hardly be said that this work has been seriously begun. I am not aware that any one has yet succeeded in raising a single sea fish; hitherto the herring have all died at or before reaching the whitebait stage, and no one has succeeded in keeping the cod, haddock, or flounder more than a few days after hatching took place. The problem therefore before us is evident enough, and, with the necessary appliances, I feel convinced it will be solved, whatever difficulties may have to be overcome.

For carrying on this work certain things are absolutely necessary, and until they are provided no real progress can be made. Of these, sea water ponds take the first and most important place. Without hatching and rearing ponds provided with a constant supply of pure sea water, which can be regulated at will, we shall never be able to learn, what is of great importance, viz., when our food fishes reach maturity, or to hatch

them in such numbers that an impression might be made on our fish supply.

The United States Fish Commission, recognising the importance of marine fish ponds, have recently, at a cost of about £10,000, constructed at Wood's Holl a large pond in which thousands of fish can be penned while the eggs are maturing; and in addition to this large pond, which is practically a harbour, a small one has been formed in which hatching operations may be carried on. In addition to ponds, it will be necessary to have two or three laboratories where the work of investigation may be prosecuted. Naturally we should prefer that one of these laboratories should be as near our own doors as possible, so that we might be able to take a real interest in the hatching and other operations, but even this desire must give way to stern necessity, for unless we conduct the operations where there is abundance of pure sea water as well as a plentiful supply of fish, we shall be courting failure at the outset. In order to satisfy all or as many as possible of the conditions so imperative, it will be necessary to erect the hatching station for the Firth of Forth at some point near the mouth of the firth.

Given ponds and laboratories, and the necessary boats and other appliances and sufficient funds to carry on the work, and powers to regulate the fishing in the territorial waters, fish culture would develop apace, and ere long, the supply of fish might be greatly increased. And not only might the fish, especially in our bays and estuaries, be increased, but our knowledge of the habits and life-history of marine forms in general would also be increased, for the appliances that are required for hatching would admit of many other important investigations being carried on. In course of time we should get to know all about the eggs and the spawning of the fish and other forms, their life-history, the nature of their food, their enemies, and their habits generally, so that ere long we might be able to transport the more valuable food fishes to our colonies, or import useful fishes from America and other countries. We should also learn much about the spawning grounds, which usually means the fishing grounds around our coast, and be in a position to prepare charts indicating the nature of these grounds, and the flora and fauna which exist in connection with them during the various parts of the year, whether at the bottom, or the surface, or in the intermediate waters.

Another question of very great importance might be settled, viz., the cause of the migration of fish, and the influence of the various modes of fishing in diminishing the supply of fish in any given piece of water.

Our ignorance as to the migration of fish has led to the appointment of numerous Royal Commissions, which have done little more than indicate that our knowledge of fish problems is extremely meagre.

If further argument is needed to show that a serious attempt should now be made to throw some light on the many obscure fishery problems, it will be found in the importance of the fisheries to the nation. It is estimated that the British fisheries are worth at first hand over £10,000,000 annually, but this really represents a much larger sum if we remember how much the price of fish increases before it reaches the consumer.

Over $3\frac{1}{2}$ of the £10,000,000 worth of fish are taken from Scottish waters, and Scottish fishermen find their way both to English and Irish fishing stations. If the sea around our coast, without any outlay on our part, without any cultivation, with, in fact, only the expense incurred in reaping the harvest, yields over 3 million pounds sterling, and if under the same conditions it has been providing us with one of our best food supplies for centuries, it is not too much to hope that advantage will be taken of the means nature and science have provided to prevent any decline, and if possible increase the supply, so that it may meet the ever increasing demand.

APPENDIX F.—No. IX.

CIRCULAR by FISHERY BOARD to FISHERY OFFICERS, giving them further instructions for the collection of material for studying the Food of Fishes.

FISHERY BOARD FOR SCOTLAND,
EDINBURGH, 18th December 1884.

SIR,—With reference to the scientific investigations which the Fishery Board has for some time been carrying on, I am directed to request that you will at your earliest convenience furnish me with a Return, on the enclosed Form, showing the property received or purchased by you, and the amount remaining on hand.

When in future you require spirit or bottles, or other appliances, you are directed to detail them in one of the enclosed Requisition Forms, sign the Form, and transmit it to me.

I am further directed to desire you to obtain as much material as possible, with the view of determining the nature of the food of all our useful fishes.

In the case of herrings, small flat fishes (soles, &c.), the stomachs to be put into the small bottles, and spirit added.

In the case of cod, haddock, whiting, &c., you will examine the stomachs, and if the contents are such as to be readily identified by you, *e.g.*, herring or other fish, well-known crustacea, &c., you will not retain them, but simply keep a note of the contents and their quantity; otherwise the stomachs should, if large, be wrapped in cheese cloth, and stored in the copper tank or other receptacle provided with sufficient spirit to cover them; and if small, should be put in the bottles.

A label in pencil to be put into each bottle, or attached to each parcel in the tank, stating shortly as far as known to you:—

To what kind of fish the stomach belonged.	Time of night or day when caught.
Length of fish.	State of weather and temperature.
Place where caught.	Proportion of stomachs examined which contained food.
Depth of water in which caught.	Date when caught, and your name.
Character of bottom.	

The small bottles should be sent up at intervals as filled. The tank should be returned when moderately full.

You are requested to continue to procure any interesting or rare marine forms, and these should, if possible, be forwarded fresh. Where distance or other cause renders this impracticable, they should be stored as above described.

You are requested also to obtain what information you think reliable, as to when the various kinds of fish feed, whether they feed at or near the surface, and whether during night or day, what kind of bottom they frequent, and what influence the weather and temperature have on their feeding and other habits, and you are further requested to construct a chart, showing where the principal 'takes' of fish have been obtained by the boats fishing in your district.

You will forward all specimens and information to Professor Cossar Ewart, University, Edinburgh.

DUGALD GRAHAM, *Secretary.*

Fishery Officer,

APPENDIX G.

THIRD ANNUAL REPORT TO THE FISHERY
BOARD FOR SCOTLAND.

BY ARCHIBALD YOUNG, ADVOCATE,
Inspector of Salmon Fisheries for Scotland.

COMPREHENDING THE

SALMON RIVERS IN THE COUNTIES OF SUTHERLAND,
CAITHNESS, ROSS AND CROMARTY, INVERNESS
ARGYLL, AND DUMBARTON.

WITH A MAP,

SHOWING THE SITUATION AND SIZE OF ALL THE SALMON FISHERY DISTRICTS IN
SCOTLAND ; THE FISHERY DISTRICTS WHICH HAVE DISTRICT BOARDS AND
THOSE WHICH ARE WITHOUT THEM ; AND THE PRINCIPAL NATURAL OBSTRUCTIONS
ON THE SALMON RIVERS OF SCOTLAND.

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EXPLANATION OF MAP.

As this Report completes my account of the Salmon Rivers belonging to the Mainland of Scotland, I have thought it not only desirable, but absolutely necessary for the proper understanding of the remarks I have made and the recommendations I have submitted, to prepare a Map showing the position and extent of the various Fishery Districts into which Scotland has been divided under the Salmon Fishery Acts of 1862 and 1868, as I know from a pretty extensive experience, that the mere mention of the statutory limits in the Byelaws constituting the various Districts, especially in remote parts of the country, conveys scarcely any accurate conception to the vast majority of persons not personally interested in, or acquainted with the Districts; whereas a Map, such as that prefixed to this Report, shows almost at a glance, not only the situation and size of every Salmon Fishery District in Scotland and the adjacent islands, but also what Fishery Districts have District Boards, and what Districts are without them. It likewise shows the position and character of the principal natural obstructions on the Salmon Rivers of Scotland. No Map of the kind, so far as I am aware, has ever before been prepared; and it was therefore necessary for me, either to draw up and publish one for the purpose of reference, or to leave many parts of my Reports unintelligible without an amount of trouble which very few readers could be expected to undergo.

This Map will show, what I afterwards point out at some length in the course of my Report, that the question of District Boards is very much a question of expense. It is not the apathy of the proprietors, but the poverty of the fishings, in the small Rivers and Districts of the west coast, that accounts for the almost total absence of District Boards in that part of Scotland. The two largest rivers on the West Highland coast, in fact the only two large rivers—the Lochy, with its tributary the Spean, and the Awe—have both got District Boards; and when we come to the east coast, where are all the great rivers of Scotland, with the exception of the Clyde, and likewise the most valuable fishings, we find that nearly all these rivers, from the Forth to the Kyle of Sutherland, both inclusive, have, and have long had, active and energetic District Boards. They can afford them, and find it worth while to have them. The west coast rivers in Ross-shire, Inverness-shire and Argyllshire, on the other hand, cannot afford them, even in the simplest and most rudimentary form. How can a river with a catchment basin of 8, or 10, or 20 square miles only, and with, perhaps, half-a-dozen bag-nets within the limits of its District, afford, by an assessment on the fishings within that District, to pay a clerk to the District Board and watchers? So far as these rivers are concerned, the system of District Boards has proved a failure; and either some other system must be devised, or else a number of these small Districts must be combined into larger Districts, in which the assessment on the fixed nets and the river fishings will be sufficient to maintain the necessary machinery of a District Board.

A very brief inspection of the Map will show that, though only about one-third of the Fishery Districts in Scotland have District Boards, this one-third has a larger watershed than that belonging to the remaining two-thirds of the Fishery Districts which have no District Boards. The average drainage area of the west coast rivers (including the Clyde), where there are scarcely any District Boards, being about 80 square miles; whilst that of the east coast rivers (not including the Tweed), almost all of which have District Boards, is upwards of 350 square miles.

The blue crosses in the Map indicate absolute obstructions to the passage of salmon, or obstructions so nearly absolute, that only one or two fish get over in the course of a year; while the red crosses indicate obstructions which partially bar the passage of salmon—that is to say, which they either surmount in floods, or only attempt to ascend, and do ascend, at a particular period of the year. The following is a brief enumeration of the absolute obstructions and of the extent of angling and spawning water which they block up. A fuller and more detailed account of them will be found in this Report and in my previous Reports to the Board.

Total, or practically Total Obstructions.

Name of Obstruction.	Fishery District.	Extent of Rivers and Lochs closed.
Falls of the Tummel †	Tay District	30 miles of river and 20,000 acres of lochs
Falls of the Lochy	Do.	10 miles of river
Obstructions on Ericht, partly natural and partly artificial	Do.	30 miles of river
Reekie Linn (River Isla)	Do.	10 miles of river
Falls of Mounessie and Inverlair	Lochy District	20 miles of river and 3 lochs
Falls of the Conon and its tributary the Orrin	Conon District	30 miles of river and 6 lochs
Falls of the Kirkaig and the Black Falls below Cama Loch	Kirkaig District	7 miles of river and 5 lochs
Falls of the Polly.	Do.	7 miles of river and 10 lochs
Falls on the Broom	Broom District	10 miles of river and 2 lochs
Falls on the Kerry	Badachro and Kerry District	5 miles of river and several lochs
Falls on Badachro	Do.	5 miles of river and several lochs
Falls on the Luinig	Loch Luinig District	9 miles of river
Falls on Balgy	...	1 mile of river and Loch Damph
Falls on the Cassley	Kyle of Sutherland District	10 miles of river
Falls on the Leven (Argyllshire)	Leven District	10 miles of river and several lochs
Falls on stream running out of Loch Ternate	Aline District	4 miles of river and Loch Ternate
Falls on Etive	Etive District	8 miles of river
Falls on Coe	Leven District	2 miles of river and Loch Treachtan
Falls on Kingairloch River (Morven)	...	1 mile of river and Loch Uisk
Falls on Aray	Loch Fyne District	3 miles of river
Falls on Avich	Awe District	1 mile of river and Loch Avich
Falls on Falloch	Clyde and Leven District	8 miles of river
Falls on Endrick	Do.	10 miles of river
Falls on Douglas	Do.	5 miles of river
Falls on the Divie	Findhorn District	10 miles of river and Loch-an-Dorbh
Falls on Farigaig	Ness District	5 miles of river and Loch Ruthven
Falls on stream from Loch Ard	Forth District	3 miles of river and 2 lochs
Falls on Duchray Water	Do.	3 miles of river
Falls on Finlas	Do.	3 miles of river
Falls on Scaur	Nith District	8 miles of river
Balgrennan Linn	Cree District	10 miles of river
		278 miles of river and about 50 lochs

* All these Obstructions, as well as those of a more partial character, will be found fully described under the heads of the rivers to which they belong, in my Reports to the Board on the Salmon Rivers of the East Coast; on those of the Solway Firth and of Ayrshire; and in this Report. The Falls of the Tummel were the subject of a separate Report, published in 1884, in the Appendix to the Second Report of the Board (pp. 152-158). I have not mentioned the Falls of Clyde in the list of total obstructions given above, not so much from the magnitude of the obstruction which they present, as from the fact that the manifold pollutions poured into the Clyde at Glasgow will always prevent salmon, in any great

If to these impassable natural obstructions we add the number of impassable artificial obstructions, in the shape of dams connected with mills and manufactories, on our Scotch salmon rivers—such as those on the Ericht, Almond, Devon, Leven, Carron, Avon, Forfarshire and Midlothian *Eaks*, the Don, the Bervie, the Lossie, and on several of the Ayrshire and Solway rivers and their tributaries—we shall probably be not far wrong if we compute the total extent of water absolutely barred against the ascent of salmon by natural and artificial obstructions at between 500 and 600 miles.

It would never pay to make several of the natural obstructions above enumerated passable for salmon. For example, the Falls of the Lochy, of the Farigaig, of the stream from Loch Ternate, of the Broom, of the Duchray Water, of the Finlas, and of the Isla. But, in many other cases, it would pay well. Notably, in the cases of the Falls of Tummel, the Falls of the Polly, the Falls on the Balgy, the Falls on the Spean, the Falls on the Conon and Orrin, the Falls on the stream that issues from Loch Ard, the Falls on the Coe, the Falls on the Avich, the obstructions on the Ericht, the Falls at Balgrenan Linn on the Cree, the Falls on the Endrick, and the Falls on the Divie.

The natural obstructions to the ascent of salmon, which impede, but do not absolutely prevent, their upward progress, and which are marked by red crosses on the map, affect, more or less, upwards of 200 miles of water; and several of them could be very greatly improved at a moderate cost. I may mention, as examples, the Falls of Rogie on the Blackwater, the Falls of the Garry, the Falls of the Morar, the Linn at Blairquhan, the Falls of the Minnock, the Falls of the Feugh, those on the Borgia, those on the Cluden Water, and the Loup of Edzell, and Loups of the Burn in the District of the North *Esk*.

numbers, from reaching them. The filth is nearly as bad an obstacle as the Falls. They will, however, be found marked with blue crosses in the map.

† In Notes IV. and V. appended to this Report there will be found a Report by Colonel Macdonald, of the United States Fishery Commission, the Inventor and Patentee of the 'Macdonald Fishway,' on the application of his Fishway to the Falls of the Tummel and the obstructions on the Ericht; also a Report by Mr Young, C.E., Perth, Colonel Macdonald's representative in this country, on the same subject. I understand that the Tay District Board and the manufacturers at Blairgowrie have come to an agreement under which Macdonald Fishways will shortly be placed on the obstructions on the Ericht, so as to open up the fine stretch of water on the Ericht and the Shee and Ardle above Blairgowrie

REPORT.

I HAVE the honour to Report that, since the beginning of 1883, I have inspected the Salmon Rivers on the East Coast of Scotland, from the Forth to the Kyle of Sutherland, both inclusive; the Salmon Rivers falling into the Scottish shore of the Solway Firth and those of Ayrshire; and the Rivers and Lochs that would be opened up by placing an efficient salmon-ladder on the Falls of Tummel.

On all these I have given in Reports to the Board, which have been printed along with its Reports to the Secretary of State.

During the past year, I inspected the Salmon Rivers in the counties of Caithness, Sutherland, Ross and Cromarty, Inverness, Argyll, and Dumbarton, thus completing my inspection of the Salmon Rivers belonging to the Mainland of Scotland; and I have now the honour to lay before the Board my Report of that Inspection.

There remain to be inspected the valuable Salmon Fishings in the Inner and Outer Hebrides, and the important Sea-trout Fishings in the Orkney and Shetland Islands which, in 1882 and 1883, were brought within the scope of the Scotch Salmon Fisheries Acts of 1862 and 1868.

THE SALMON RIVERS OF SUTHERLAND.*

The Salmon Rivers of this county belong to the Duke of Sutherland, who is the sole proprietor. There are no conflicting interests, no disputes between upper and lower proprietors; and the result is that the rivers are in general admirably managed, with due regard to both the angling and the netting interests. It might, however, be desirable to have some more effectual means of compelling the bag-net fishermen, especially on the west coast, to observe the weekly close time, when not absolutely prevented by stress of weather, more strictly than they do now.

The Fleet.

This small river rises 750 feet above the level of the sea, about 2 miles from Lairg Church, and from thence runs east-south-east for 17 miles, till it joins the Dornoch Firth 2 miles from the town of Golspie. Near its mouth, it is crossed by a mound 995 yards long, over

* The River Shin—although a Sutherland river—is not included in the present Report, because I have already described it in my Report of 1883 to the Fishery Board on the Salmon Rivers on the East Coast of Scotland from the Forth to the Kyle of Sutherland, both inclusive.

which the public road between Golspie and Dornoch passes. This mound is pierced by four arches, furnished with sluices for the passage of the river and tidal currents. Above the mound, the river forms a sort of swampy lagoon, while, below, it broadens into an estuary. Above the mound, there is occasionally very good sea-trout fishing with the fly—the trout being of exceptionally large size: and about 3 miles below, in what is termed Loch Fleet, where the tide runs with great rapidity, there is a famous cast, where salmon are sometimes taken with the rod and fly in the salt water, the best time being about three-quarters of an hour after the ebb begins. The late Mr Bateson of Cambusmore frequently caught salmon here with the fly. It is almost the only place in Scotland where this can be done. The Fleet is a late river; and the Cambusmore keeper, who is thoroughly acquainted with it, told me that the first clean salmon do not run up until the end of May or beginning of June. The grilse run in July. It is somewhat strange that, while the Fleet is so late a river, the Brora and Helmsdale, the two rivers nearest it, are both very early. It would be worth inquiring whether the construction of the mound, which was finished in 1816, had anything to do with making the Fleet late. The Fleet is a good spawning river. The most interesting object in the basin of the Fleet is the salmon-ladder at Strathcarnack, which enables salmon to ascend a fall, 60 feet high, on the Carnack, a tributary of the Fleet. It is thus described in the Appendix to the Report on the effect of recent legislation on the Salmon Fisheries in Scotland, drawn up by Mr Buckland and myself, and published in 1871:—

A ladder constructed on a most ingenious plan by J. Bateson, Esq. of Cambusmore, on the Carnack, which runs into the River Fleet in Sutherlandshire. The principle adopted is that of a ladder within a ladder, or, to describe it more correctly, of a series of pools connected with each other by short ladders.

The retaining walls forming the pools are roughly but massively built of stones, but without mortar. The interstices being stopped with moss, which arrests the silt and organic matter carried down by the stream, the walls soon became sufficiently water-tight. In order to secure these walls or steps from the risk of being damaged by spates, a sluice is provided at the head of the pass, which prevents the admission of a greater quantity of water than is sufficient for the passage of the fish.

The total length of the ladder is 378 yards. The fish are taken up an exceedingly precipitous incline, 138 yards long, at a gradient of about one in four, by means of a series of twenty-three 'ladder-within-a-ladder' pools. The remaining part of the pass is not so steep; there are no pools in it, but only half-steps at intervals to break the water. This part of the ladder is 240 yards in length. The total height from water to water is between 60 and 80 feet. Mr Bateson deserves great credit for this most ingenious and efficient pass, which he constructed at his own expense.

I am sorry to say that, when I again visited this ladder in June last, I found that it had got very much out of repair, not having been kept in order since Mr Bateson's death some years ago. Many of the pools have got silted up with sand and gravel, and the moss which used formerly to be placed in the interstices between the stones has been washed out and has not been replaced. A very moderate outlay, however—say £15 or £20—would put all this to rights. This ladder goes round the fall, up a natural hollow or ravine. There are two sets of pools—a larger and a smaller set—in the breadth of the ladder. A large pool on the right hand side and a small one on the left; then, immediately below, a large one on the left and a

small one on the right. When the ladder is filled with water, the keeper told me that the fish can pass up with ease. Seven salmon have been taken with the landing-net out of one of the pools of the ladder, and they have been caught with the fly in the stream 3 miles above the top of the fall. They have also been seen, though not captured, in Loch Buie, 5 miles above. Excellent baskets of sea-trout have likewise been got with the fly in the stream above the fall. This ladder has now been in use for nearly twenty years. It cost between £500 and £600 originally, and was, unquestionably, the earliest successful attempt in Scotland to pass salmon over a great natural obstruction. Wherever there is a ravine or hollow by the side of a waterfall, the plan of the Strathcarnack ladder might be advantageously adopted.

The Brora.

The Brora is an early and excellent salmon river. It has a course of about 25 miles, and falls into the sea at Inverbrora. Its principal tributary is the Blackwater. At one part of its course the river expands into a spacious loch called Loch Brora, the foot of which is about 4 miles from the sea. This loch abounds in salmon, sea-trout, and loch trout. It is about 4 miles long, and in the widest part nearly half a mile across. It is divided into three portions, united by narrows not above 70 yards wide. A little way above Loch Brora, the river rushes over a considerable fall, beneath which is a deep and spacious pool known as the 'Fall Pool.' I have often watched salmon in summer and in early autumn, ascending this fall, but the spring fish never attempt to surmount it. The keeper at Balnacoll told me that he had observed, year after year, that the fish begin to ascend the fall much about the same time. On the 4th, 11th, and 12th May, in three successive years, he had noticed the salmon commencing to leap the fall. Immediately above the fall, the river rushes for some distance through a rocky and picturesque gorge, where apparently there are a number of the most splendid angling pools possible. Yet salmon scarcely ever rise to the fly in them, and it is not until you emerge from the gorge, and reach a spot where the river flows through a comparatively wide and level strath, that there is any chance of sport. The keeper at Balnacoll has been five years on the Brora. He has captured 57 fish with the rod in 14 days; and, in the most productive year since he came, 273 salmon were killed by angling. The best fishing is over by the middle of May, and there are plenty of clean fish on the opening day, the 11th February. The grilse begin to run in May. During the last three years, the take of fish has increased, chiefly owing to the favourable weather.

The mouth of the river is netted, and so also is Loch Brora. Last year, I was told that about 1000 salmon had been taken by the net from the loch. One thoroughly competent and experienced local authority expressed to me his opinion that the spring fishing, and the fishing generally, would be much improved if the netting was confined to the loch, and the mouth of the river was not netted. But he thought that the netting on the loch should not commence until the month of March. The Brora has been famous for its wealth of salmon for more than two centuries; and in his *Northern Memoirs*, written in 1658, Franck thus speaks of it:—

The next thing we meet with, is the Lough Broroh, that spouts forth a river into the bowels of the ocean. This lough is deep, but not so large

as the Ness, but very full of salmon ; and though the river seems to have rapid streams, yet the tides influence them every 12 hours. I mention this Broroh for no other purpose than to reflect on her plenty of salmon, where they barrel up for France and other parts annually (as reported), so much salmon as amounts to £300 sterling a year ; and the price of a salmon (among themselves) seldom exceeds one single denare.

Sir Humphrey Davy, in his *Salmonia*, also writes of the productiveness of the Brora :—

The Brora, Sutherland, in 1813 and 1814, was an admirable river ; I have often rode from the mansion of the princely and hospitable lord and lady of that county, after breakfast, and returned at two or three o'clock, having taken from 3 to 8 salmon—several times 8. There were five pools below the weirs of the Brora, which always contained fish ; and at the top of one pool, which from its size was almost inexhaustible, I have taken 3 or 4 salmon in the same day. Another pool nearer the sea was almost equal to it ; and at that time I should have placed the Brora above the Ewe for certainty of sport.

Between 1864 and 1881, both inclusive, the best year on the Brora appears to have been 1874, when 26,025 lbs. weight of fish were captured, and the worst year 1865, when only 3971 lbs. were taken. But the take during the last 9 of these 18 years very greatly exceeds the take during the first 9 years of the period ; the take for the first 9 years (from 1864 to 1872 both inclusive), amounting to only 80,078 lbs. ; while the take for the last 9 years amounts to 147, 639 lbs.

When I inspected the Brora in 1878, there was a hatchery for the artificial propagation of salmon belonging to the Duke of Sutherland. It then contained 340,000 salmon eggs from the Brora, Helmsdale, Thurso, and Rhine. These were placed on gravel in the ordinary old-fashioned wooden troughs, which are inferior in every way to the troughs of carbonised wood, with glass rods placed side by side, and the eggs arranged between them, such as are used by Sir James Maitland at his great piscicultural establishment at Howietoun, near Stirling. The Brora hatchery has now, however, been given up, as the results obtained from it were not considered satisfactory. It has not been stocked for four years, and it is understood that the Duke of Sutherland has no intention of resuming operations. The tacksman of the Brora net-fishings states that he is opposed to artificial breeding on the Brora—(1) because many of the young fry die when put into the river, or are devoured by larger fish ; (2) because there are not nearly so many young fry returned from the hatchery into the river as there are eggs taken from the spawning fish removed from it ; and (3) because, on the best natural spawning beds, there are not one pair of fish now for ten that there used to be five years ago. The breeding operations on the Brora seem to have been unlucky ; as in a letter of 23rd August 1881 from Mr Thomson, lessee of the net-fishings on the Helmsdale, to Mr Peacock, the Duke of Sutherland's factor at Golspie, it is stated that Mr Thomson saw the young artificially-bred fry lying dead in thousands in one of the burns in which they had been placed.

The Helmsdale.

This is one of the very best spring rivers in Scotland ; and next to the Naver, it is probably the earliest river in the county of Sutherland. It is formed by the confluence of two streams, one rising in

Loch Liem-na-Claven on the skirts of Ben Griam More, 770 feet above the sea, and the other issuing from Loch-na-ruar. From the confluence of these two streams, the Helmsdale flows 20 miles in a south-easterly direction through the Strath of Kildonan, and enters the sea close to the fishing village of Helmsdale. Its most important tributary joins it near Kinbrace, after passing through a series of lochs, of which the uppermost, Loch-na-Cuen, is 3 miles long, and covers an area of 716 acres; the second, Loch-na-Clair, is $1\frac{1}{2}$ mile long by 1 wide; while the Baden Loch is $1\frac{1}{2}$ mile long and from $\frac{3}{4}$ of a mile to a mile wide; the two last named having together an area of 1536 acres. Lower down, there is a much smaller and shallower loch (Loch Auchnahu), in which there is good salmon fishing. There is no barrier to the ascent of salmon from Loch Auchnahu into the larger lochs above, and yet salmon are scarcely ever caught in them. But, in 1877, I picked up a salmon of 12 lbs. weight which had been washed ashore on the banks of Loch-na-Clair, the middle loch; so the fish are there. A fine stream runs into the north end of Loch-na-Cuen, the uppermost of the chain of lochs. This is formed by two large burns, which unite shortly before the junction of the main stream with the loch. One of these is called the Rimisdale Burn, and the other Loan-a-Chaoil Burn. The latter rises not far from the sources of the River Strathie, which falls into the Pentland Firth at Strathie Bay. The Rimisdale Burn has a very winding course between Rimisdale Bridge and its junction with its sister burn, a distance of quite a mile, following the windings of the stream. I walked along its banks, and found that, during the greater part of its course, there is splendid spawning ground composed of fine gravel or small stones. Many of these spawning beds are from 20 to 40 yards long; and even in the unusually low state of the burn when I visited it, they had a sufficient depth of water over them for any salmon. In the spawning season there would generally be much more water than at the time of my inspection. Below the point of junction, the Rimisdale and Loan-a-Chaoil burns form a still, deep stream from 10 to 20 yards wide, which, after a course of nearly half-a-mile, flows into the head of Loch-na-Cuen. There is probably a sufficiency of good spawning ground in the lower part of the Helmsdale and its tributaries; but the course of the Rimisdale between the bridge and its junction with the Loan-a-Chaoil would not be a bad place for a small breeding establishment; and if the smolts artificially bred there and put into the burn should return from the sea to breed there in the natural way, the effect might be greatly to increase the number of salmon in the three magnificent lochs below. There are no obstructions on that branch of the Helmsdale which flows out of Loch-na-ruar, and plenty of water for fish to run when the river is high, yet I have never heard of salmon being caught in that loch. The trout-fishing in all the lochs connected with the basin of the Helmsdale is excellent, the trout being pink-fleshed, handsome in shape, and well-flavoured; in proof of which I may mention that, a good many years ago, I and two friends killed with the fly in five consecutive days 600 trout, weighing 450 lbs., in the Baden Loch, Loch Liem-na-claven, and Loch-na-ruar.

As I have already stated, the Helmsdale is a very early river. The oldest and most experienced keeper in the Strath of Kildonan told me that, in the early part of the present century, 60 clean salmon were taken out of the Manse Pool at a single haul of the net on the day before Christmas. The spring salmon average about 9 lbs. weight. The lessees of the rod-fishings rent the nets at the mouth of the river until

the 1st of May, so that the salmon have nothing to hinder their free access to the fresh water ; and to this, undoubtedly, is to be imputed, to a great extent, the excellence of the angling. About 6 miles above the village of Helmsdale, there is a place where the river is deep, broad, and still for about a couple of miles. Here fish lie and may be taken, when a good breeze ruffles the surface of the water, when the pools above and below are too shallow and clear to be fishable. In Loch Auchnahu also, salmon may be taken with the fly when the pools in the river are too low. There are 10 or 12 good pools between the long stretch of still water above alluded to and the village of Helmsdale, and at least twice that number above the head of the still water. One of the most successful anglers on the Helmsdale and also the most experienced keeper, both told me that salmon should not be allowed to be taken in the month of October, as they are far advanced towards spawning at that time, and are not fit for human food. They propose that the rod season on the Helmsdale should be from 1st February to 15th September; at present it is from 11th February to 31st October. It has also been proposed by others that the angling season should be from 15th January to 1st September. I believe that the advocates for these changes are quite right in saying that the angling season is at present too prolonged; and I think that from 1st February to 15th September would be a change for the better.

The Helmsdale is a most productive angling river, and I have no doubt that this is in a great measure due to the fact that the angling lessees rent the nets up to 1st May. As many as 900 salmon and grilse have been caught by the rods in a single season. In 1882, one lessee on the river had 320 fish; and in 1884, up till 26th April, his sport was also excellent. The first clean salmon are taken on the opening of the season. Grilse are not plentiful until the end of May or beginning of June; but they have been caught as early as the 1st May.

In 1876, 5116 lbs. of salmon and 22,167 lbs. of grilse were caught by nets in the district of the Helmsdale, and nearly as much in 1871 and 1873; and there seems no appearance of any tendency to diminution either in the angling or the netting.

The Halladale.

This river is said to take its name from Halladha, son of Ronald first Earl of Orkney, who was slain in battle and buried in the strath through which the river flows. The scene of the battle is about the middle of the strath, where the natives still point out a hillside covered with cairns where the dead were buried; it is called Dal Halladha, and a deep circular trench 12 feet in diameter, with a large stone in the centre, marks the spot where Halladha and his sword were laid. The Halladale is but a poor fishing stream compared with the Helmsdale or the Brora. I never heard of more than 90 fish having been killed in a season, and less than half that number would now be deemed a good year's fishing. One great reason of this certainly is that, owing to an unintelligible Estuary Byelaw, bag-nets are allowed to fish much too close to the mouth of the river, and to intercept the ascending fish. Another cause is, that as the supply of water is only from hill burns and small lochs, the river soon runs out. The Halladale rises close to the Caithness border, $4\frac{1}{2}$ miles from Forsinard Station. It has a course of fully 20 miles through Strath Halladale,

and falls into the North Sea at the Bay of Bighouse. The Dyke, which is a good sea-trout stream in the latter part of the season, is its chief tributary. The spring fishing in the Halladale is from the wooden bridge to the mouth of the river, a distance of about 7 miles. After the month of June, the salmon run further up; and the best fishing, in summer and autumn, is in the rocky pools between the wooden bridge and Forsinard. The bye-law fixing an estuary line for the Halladale, which came into operation on 11th March 1865, is in the following terms:—‘A straight line drawn due west across Melvert Bay, from the most projecting point of salmon rocks on the east.’ But no one in the neighbourhood, or anywhere else, knows of any ‘salmon rocks’ in or near Melvert (it ought to be Melvich) Bay; and of course the lessee of the bag-nets takes advantage of this, and selects the rocks nearest the river’s mouth as the ‘salmon rocks.’ This bye-law imperatively demands revision. The natural and proper estuary, it humbly seems to me, would be a line drawn from horn to horn of the Bay of Melvich.

There are several excellent trouting lochs in the district of the Halladale, the best of which are Sletill, Acron, and Loch-na-Shealg. In the first named, which is a small remote loch about 6 miles from Forsinard Station, the keeper to Mr Paterson of Bighouse and a gentleman killed in one day, a few years ago, 120 trout, weighing 87 lbs. The Sletill trout are remarkable for their beauty and fine quality, and for the sport they show when hooked.

The best netting year on the Halladale of which I have received returns was 1867, when 2139 lbs. of salmon and 13,634 lbs. of grilse were captured.

The Strathie.

This is a small river which, rising in Loch Strathie, falls into the sea to the east of the bold projecting rocky headland called Strathie Point. It is more a grilse and sea-trout than a salmon stream. There are net-fishings at the mouth of the Strathie, which in 1865 yielded 1730 lbs. of salmon and 4383 lbs. of grilse; and in 1867, 890 lbs. of salmon and 7358 lbs. of grilse.

The Naver.

This is much the largest and best river on the north coast of Sutherland. It is also the earliest. It issues from Loch Naver, which lies at the foot of the lofty Ben Klibrick, 3154 feet in height, from which it flows for 19 miles through one of the most fertile and beautiful pastoral straths in the county of Sutherland, in some places spread out in broad green meadows and in others hemmed in by steep hills with birch-clad slopes. It falls into Torrisdale Bay a little more than a mile east of Bettyhill of Farr. Loch Naver is a fine sheet of water, $6\frac{1}{2}$ miles long by $\frac{1}{2}$ a mile wide. It is in some places 30 fathoms deep. It receives at its head the river Mudale, and is fed by 16 other streams large and small. Its waters are well stocked with salmon, grilse, and sea-trout, but the fishing for brown trout is indifferent. It is a very early loch, the fishing being good in February and March. As many as 52 salmon have been killed in it by one rod in seven weeks and 6 in a single day. They are mostly got by trolling, though they have also been captured with the fly. The best fishing is at the upper

and of the loch. A little below the point where it issues from the loch, the Naver receives the waters of the Mallart, a considerable stream, which has a course of $7\frac{1}{2}$ miles from Loch Choir, a large but remote loch lying at the back of Ben Klibrick. The Naver is divided into 6 angling beats, which let for £100 a year each; and in a good year they are well worth it, as many as 40 salmon having been killed in a fortnight by one rod. Before the passing of Home Drummond's Act of 1828, many excellent clean salmon used to be caught in the Naver in December. The Commissioners under the Salmon Fishery Act of 1862, fixed its close time for netting from 27th August to 10th February, with extension of time for rod fishing to 31st October. This has, however, been changed by Order under the Secretary of State's hand, and the angling season now extends from 12th January to 10th September. I have the returns of the netting in the Naver District from 1865 to 1876, both inclusive. They are as follows:—

Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.
	lbs.	lbs.		lbs.	lbs.		lbs.	lbs.
1865	3787	4,140	1869	3304	3262	1873	3372	10,086
1866	2340	6,243	1870	2953	4901	1874	5977	18,771
1867	3334	14,965	1871	2955	6216	1875	6309	13,408
1868	3908	2,421	1872	3700	8067	1876	5076	10,137

The Borgia.

The head waters of the Borgia run into a small narrow loch called Loch Coulside, and on issuing from it flow through a fine series of lakes about 10 miles in length, consisting of Loch Laoghal, Loch Craggie, and Loch Slam, to all of which salmon have access when the river is high. The Borgia has a course of about 9 miles after it issues from Loch Slam and falls into the sea at Torriisdale Bay at a point about a mile west from the mouth of the Naver. There is one considerable fall on the Borgia between Loch Slam and the sea. It forms an impediment, though not an actual barrier to the passage of salmon, and it would be a great improvement to the upper fishings if it were made more easily passable. This might be effected without much difficulty or expense, by judicious blasting on the right bank of the river. Salmon and grilse are caught every year in Loch Slam, the lowest of the chain of lakes through which the Borgia flows, and less frequently in Loch Craggie and Loch Laoghal. But the angling is not nearly so good as it used to be. I met an English gentleman at Tongue who had fished in these lochs forty years ago, and he told me that, in one day, he had hooked 9 salmon in Loch Slam and landed 7; that is about as many as are killed in a whole season now-a-days. In the latter end of the year, salmon run up through the whole chain of lakes in the basin of the Borgia to spawn in the stream that runs into the head of Loch Coulside, which has a course of 5 miles, and contains some excellent spawning ground. An experienced local fisherman told me that he had seen as many as 30 pairs of salmon spawning on the redds there in the end of autumn. But it is to be feared that very few of the smolts bred there will ever reach the sea, as, before doing so they must run the gauntlet of four lochs full of yellow trout, their natural enemies and destroyers. The trouting in all these lochs is

excellent both with fly and minnow. There are a good many *Salmo ferox* both in Craggie and in Laoghal.

There are two fairly good casts for salmon, at certain states of the tide, in the salt water in the Kyle of Tongue; and salmon and sea-trout are also captured by trolling with the natural sand eel in the rapid current of the Kyle.

There are bag-nets in Torrisdale Bay, into which both the Naver and the Borgie falls. The following is a return of the fish caught by the nets in the Borgie District from 1865 to 1876, both inclusive:—

Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.
	lbs.	lbs.		lbs.	lbs.		lbs.	lbs.
1865	3,611	3,731	1869	2,460	4,173	1873	1,576	5,376
1866	1,747	5,977	1870	1,211	2,865	1874	4,189	15,765
1867	1,697	5,969	1871	1,449	2,963	1875	2,408	5,566
1868	1,995	1,777	1872	862	1,970	1876	1,273	3,944

The Kinloch.

This little river rises amidst magnificent mountain scenery on the west side of Ben Laoghal. It flows out of Loch-an-Deer, and falls into the head of the Kyle of Tongue. Near the Shooting Lodge, a little more than a mile from the mouth of the river, there is a considerable waterfall, and below it a spacious pool which is a favourite lie for salmon. In the latter part of the season, however, they manage to ascend this fall, and are caught in some of the pools between it and Loch-an-Deer. The Kinloch is reserved entirely for angling. It rises and falls rapidly, and is not a river to be depended upon for sport. There are several lochs above Loch-an-Deer belonging to the basin of the Kinloch, one of which, Loch-na-Halm—a star-shaped loch 13 miles from Tongue Hotel and 8 or 9 from Altnahara—is probably the best trouting loch in the whole district. On one occasion, along with a companion, I captured in five hours, on a day by no means favourable, 108 beautiful trout, weighing 45 lbs. I have never heard, however, of salmon reaching this loch.

The Hope.

The Hope is formed by three streams which have their sources on the southern confines of the district of Durness. It runs through Strathmore for 6 miles, past the birch-clad slopes at the base of Ben Hope, and falls into the head of the fresh water Loch Hope—a beautiful lake nearly 6 miles long and from a furlong to $\frac{3}{4}$ of a mile in width—from the foot of which it has a farther course of about 2 miles, and finally flows into the south-eastern side of Loch Erribol, the safest and most spacious harbour on the north coast of Scotland. Salmon, grilse, and sea-trout, as well as yellow trout from 10 lbs. downwards, are found in Loch Hope. But it is an uncertain and precarious loch for fishing. There are some good salmon pools on the upper Hope, or Strathmore River, in the three miles of its course between Dun Dornadilla—said to have been a hunting residence of the ancient Scottish kings—and the head of Loch Hope; and in the

lower river, between the foot of the loch and the sea, there are likewise some good casts, particularly one below the old cruive dike, now no longer in use.

The following is a return of the weight of salmon and grilse caught by the nets in the district of the Hope from 1865 to 1876, both inclusive :—

Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.	Year.	Salmon.	Grilse.
	lbs.	lbs.		lbs.	lbs.		lbs.	lbs.
1865	2,468	5,314	1869	1,871	4,352	1873	1,799	3,356
1866	1,905	8,776	1870	2,396	2,756	1874	2,250	9,434
1867	2,544	8,359	1871	2,653	3,941	1875	2,301	3,246
1868	3,395	3,395	1872	not	fished	1876	1,894	6,031

Early and Late Salmon Rivers.

The Hope is a later river than any of those that run into the Pentland Firth to the east of it. Indeed, it may be said that with the Hope the late rivers begin ; as all the rivers westward from it to Cape Wrath, and southward from Cape Wrath along the west coast of Scotland and up to the head of the Scotch shore of the Solway Firth, are, with scarcely an exception, late ; whereas, almost all the rivers eastward of the Hope, between it and Duncansby Head, and southwards between Duncansby Head and the Tweed, are early. The cause of this lateness or earliness I believe to arise from the relative temperatures of the fresh water of the rivers, and of the sea into which they fall. I stated this theory in letters to the *Scotsman* in October and November 1875 ; and afterwards more fully in my Treatise on *Salmon Fisheries*, in Stanford's series of *British Industries*, and in the *Journal of the Scottish Meteorological Society* in 1878. The Scottish rivers running into the German Ocean are almost all early rivers. They have comparatively long courses, and fall into the sea at considerable distances from their mountain sources, after running during some part of their career through districts not greatly elevated and possessing a moderate climate. But the German Ocean, into which these rivers flow, is a cold sea ; and in winter and early spring the river temperature is, in ordinary seasons, probably higher than that of the sea, and therefore salmon ascend these rivers early in the season. Take the Tay, for example. It is well known that salmon run into it in great numbers in the months of December and January, so that, when the fishing begins in February, Loch Tay is stocked with clean and heavy salmon. On the west coast, on the other hand, the rivers that fall into the Atlantic are nearly all late. They have short courses, and their fountain heads are much tilted up, as they rise in that lofty and singularly picturesque chain of mountains which, beginning not far from Cape Wrath, skirts the shores of Sutherlandshire, Ross-shire, and Inverness-shire for more than 100 miles, at distances varying from 5 to 20 miles from the western sea. In winter and spring, and sometimes even in early summer, these mountains are snow-clad or partly covered with snow, and every partial melting of their snows brings down torrents of ice-cold water, which rush through the short channels of these rivers into the sea. But the water of that sea, unlike that of the German Ocean that washes our

eastern shores, is warmed by the soft influence of the Gulf Stream, and the salmon, consequently, prefer to remain in it until the snow-water has run off, and the milder weather of June and July has raised the temperature of the river waters, and then they begin to ascend. In order to test the correctness of the theory above stated, careful and prolonged observations on the relative temperatures of several late and early rivers, and of the sea into which they flow, would be necessary. Such observations have been made for some years past by the Scottish Meteorological Society at their station at Inverugie, on the east coast, and I believe also by the Duke of Sutherland on two early and two late salmon rivers. A very ingenious apparatus has been devised by Mr Thomas Stevenson, C.E., for observations of sea and river temperatures by means of thermometers continuously immersed. If the result of such observations, carried on for a sufficient length of time, shall be to prove the correctness of the theory above stated, we shall obtain something approaching to a scientific method of determining the annual close time suitable for each river. Another result will be to prove the futility of all attempts to change late rivers into early ones by stocking them with salmon bred from ova taken from early rivers. For, if the theory with regard to the constant and invariable effects of the relative temperatures of the sea and of the rivers which fall into it, upon the earliness or lateness of the ascent of salmon be correct, it seems quite clear that all such attempts are a mere waste of time and money. As long as the physical characteristics of the river proposed to be converted from a late into an early salmon river, and of the sea at its mouth remain unchanged, the mere introduction into a late river of fish taken from an early river will have no effect. The river will modify the habits of the fish; but the fish will never change the character of the river.

Polla or Strathbeg.

This small stream, which flows through Strathbeg amidst some of the grandest scenery in Sutherland, and falls into the head of Loch Erribol, is included in the same district as the Hope, and has the same estuary line. Between the bridge over the high road and the junction of the Polla with Loch Erribol, there are three or four deep rocky pools, where, at certain seasons and states of the tide, there is first-rate angling for sea-trout. I have taken them 4 lbs. weight, and I have no doubt that grilse also may occasionally be caught. But the Polla is a mountain stream that rapidly rises and as rapidly falls, and the angling is very uncertain.

The Grudie or Dionard.

This is an excellent salmon river, though not nearly so good as it was before the bag-nets were set up in Balnakill Bay, outside the Kyle of Durness, into which it falls. It rises at the foot of a gigantic precipice, forming part of Meallhorn, one of the Stack Forest mountains; traverses two small lochs; and then opens out into the wider expanse of Loch Dionard, from which it has a course of 14 miles to the head of the Kyle of Durness. Its upper part is very inaccessible. There is not a vestige of a path; and it cost me a rough mountain walk of 14 miles from the keeper's house at Gualin

and back to inspect it and Loch Dionard, 1380 feet above the sea. Salmon, grilse, and sea-trout ascend to Loch Dionard, and one of the best casts in the river in summer and autumn is just where it issues from the loch. There is also a good cast on the stream between Loch Dionard and the smaller loch above, from which seven fish have been taken by one rod in a day. There are some long, deep, but somewhat still pools below the bridge on the high road between Durness and Gualin, in which the fish are found in the earlier part of the year; but after May they leave these pools, and ascend to the rougher streams and pools between the bridge and Loch Dionard. The upper part of the Kyle of Durness is a sandy flat, dry at low water. But farther down, near the ferry, where there is a strong current, there is capital trolling for sea-trout in the salt water, using the natural sand eel for bait. The Grudie is a late river. There is no good fishing in spring. The grilse run in July. The keeper at Gualin House, who has had a long experience of the Grudie, told me that, in former years, he had seen 14 salmon taken and 9 lost by one rod in a single day, and also that he had seen Mr Trevillian, the former lessee, take 8, 10, and 12 fish in a single day when the river was in good order. At that time, there were no bag-nets on the coast, and he imputes the present falling off in the angling to the placing of these nets too near the mouth of the river. There is capital spawning ground throughout the course of the Grudie between the bridge on the high road and Loch Dionard.

The Inchard.

After leaving Durness, and crossing the long and steep hill, on the summit of which stands Gualin House, I descended upon Riconich, and reached the Inchard, the northernmost of the salmon rivers on the western seaboard of Sutherland. This is but a small stream, less than the Polla, of a rough and brawling character, and having scarcely any pools in which salmon can lie. It is only 2 miles in length, and falls into the head of the salt water Loch Inchard. It drains two considerable fresh water lakes, Loch Garbetbeg and Loch Garbetmore; and connected with its basin there is a chain of lochs lying in the recesses of a deep and wild corry between Foinaven and Arkle, two of the principal mountains of the Stack deer forest. The Inchard is not of much value as an angling river. Salmon and sea-trout run right through it into Loch-Garbetbeg. They do not ascend till late in the season, and it is June or July before the loch is fully stocked. Capital sport may afterwards be had in the loch; one visitor in Riconich Inn having taken 62 and another 40 salmon from it in the course of a single season. The stream which connects Loch Garbetbeg and Loch Garbetmore is a mere burn with a few deep holes in it. Loch Garbetbeg is a comparatively shallow and reedy loch, while Loch Garbetmore is deeper and freer from weeds. The latter is said to contain large yellow trout and likewise *Salmo ferox*.

Not far from Riconich on the road to Scourie, there is a fresh water loch communicating with Loch Inchard by a short burn, with a rough stony channel. This loch is the lowest of a series of small lochs, all connected together, so that it would be worth while to do something to facilitate the ascent of salmon and sea-trout. Efforts have already been made in this direction by clearing out stones from the bed of the

burn, by forming pools, and by building out rough piers from each side of the burn, connecting the lowest loch with Loch Inchard. These efforts are said to have been to a certain extent successful, as I was told that large sea-trout have been occasionally captured in the lowest loch.

Loch Sandwood and the River Shinary.

Having heard that Loch Sandwood, a large and deep sheet of water, whose western extremity is quite close to the sea, about 7 miles south of Cape Wrath, had at one time been a good salmon loch, but had ceased to be so since the communication between it and the sea had been silted up by sand, I drove to a schoolhouse 7 miles from Riconich. and, getting a guide there, walked across the moor to the loch, a rough boggy tramp of 4 miles. A small river called the Shinary, whose source is not far from Gualin House, falls into the head of Loch Sandwood. I reached this river about a mile above its junction with the loch. It has some promising-looking rocky pools, and there are said to be several deeper ones 3 miles farther up. There is also some good spawning ground. A little below the pools where I first struck the river, the stream is still and deep, with a fine gravelly bottom in many places, well adapted for spawning purposes; and as the river, when I inspected it, was lower than it is likely to be in the spawning season, there would always be water enough to cover the ova deposited, if only fish were enabled to ascend from the sea. Loch Sandwood is a considerable sheet of water, circular, or rather oval in shape, and covering, I should think, about a square mile or 640 acres. The south side is very deep all along until quite close to the sea. In places it is bounded by low cliffs, and there are large boulders of stone extending out into the loch, just such a shore as salmon love to hunt. The north shore is also deep, but not so deep as the south. The loch is in general free of weeds, and it should be a splendid loch for trolling. A local fisherman told me that he had caught trout 5 lbs. weight with the fly, and that a good while ago there was a salmon station close to the mouth of the loch. Unfortunately, the westerly winds bring in a very heavy sea, which rolls in over a sandy beach, so that the entrance to the loch is now almost entirely silted up by the accumulation of sand washed in. At the time of my visit, there were mere rills of water trickling into the sea, quite insufficient for the passage of a salmon or even of a sea-trout. The best place to clear a passage for fish would be on the south side, close to a great mass of smooth rock that stands out above the sand like a wall.

The Laxford.

From Riconich I proceeded to Scourie, inspecting the Laxford by the way. As its name implies (Laxford, salmon firth), this is one of the best angling rivers in Sutherland. It is a late river, the principal fishing months being June, July, and August. It issues from Loch Stack, and, after a course of $4\frac{1}{4}$ miles, falls into the head of Loch Laxford. The public road crosses it by a stone bridge about a quarter of a mile before it joins the salt water. Two thousand five hundred salmon and grilse are said to have been taken out of this short but most productive river in the course of a single year. Throughout its whole course, it is a perfect model of a salmon river, swift sparkling streams alternating

with deep and spacious pools; in fact, it is almost all good fishing water. It is a splendid river for sea-trout, which in it and in Loch Stack are both numerous and large, many of them being 5 lbs. in weight. The Laxford salmon average about 10 lbs., and the grilse about 6 lbs. Twenty years ago, before there were any bag-nets on the coast, 80 salmon and grilse were taken with the sweep net in a single haul, from the pool below Laxford Bridge, and 14 fish have been captured in a single day by one rod out of the pool known as the 'Duke's Pool.' I followed the whole course of the Laxford, walking down the footpath on the Scourie side of the river from Stack Lodge to Laxford Bridge, and in that space of only a few miles I passed 20 good fishing pools. In fact, a finer combination of pools and streams could scarcely be imagined or desired.

There is a small river called the Duartmore, within the limits of the district of the Laxford, which is connected with several lochs, to which salmon and sea-trout might be admitted without much trouble or expense. There is a fall a little way up from the sea, and an attempt has been made to make it accessible for salmon, but the result has not as yet been quite satisfactory. The tide comes up to the foot of the second lowest pool in the river, and the river should be pooled in several places between the fall and the sea, so as to afford more lies for salmon. There are plenty of stones lying handy for the purpose. A subsidiary dam should be made in the narrow part of the stream some 30 or 40 yards below the fall, and the run or cut at the top of the fall should have an additional resting pool. There are about 2 miles of river and two lochs below the bridge by which the high road crosses the Duartmore; one small loch above the bridge; and then a fine sheet of water about 3 miles in circumference above that. To all of these sea-trout, grilse, and salmon occasionally find their way. But I venture to think that the fishing might be much improved by putting in a subsidiary dam below the fall as above suggested, and also by establishing a small hatchery for the artificial breeding of salmon on the head waters of the Duartmore.

The Inver.

The Inver is a river of Assynt, one of the wildest and most picturesque districts in Sutherland, having an area of 100,000 acres, much of which consists of rugged and lofty mountains, and of inland lochs, of which there are no fewer than 200, ranging in size from Loch Assynt, 7 miles long, and in many places a mile wide, to the lakelet only a mile in circumference. This is without counting mere lochans or mountain tarns. The Inver flows out of Loch Assynt, and has a course of about 6 miles before it falls into Lochinver. In its upper part it is comparatively shallow, with a beautiful gravelly bottom; but in its lower part there are a number of fine rocky pools, which sometimes in the summer and autumn yield good sport to the angler. The Inver is a late river. The fishery officer informed me that the fishing in the Inver and Kirkaig, the two chief salmon rivers in Assynt, had fallen off very much, which he imputed to the number of bag-nets on the coast. An accomplished naturalist, who is also an experienced and successful angler, and who has personal knowledge of the Inver, Kirkaig, Duartmore, Grudie, Naver, and Borgia, writes me as follows about these nets:—

Entirely dissatisfied with the present weekly close time, the disregard paid to it by the lessees of nets, and the utter inadequacy of the means taken to enforce it, and of the penalties inflicted by the sheriffs, for example, in the case of the Duke of Sutherland *v.* Speedie. Speedie was convicted of having on one occasion 43 nets fishing illegally; yet the sheriff fined him only 5s. a net and £3 of expenses.

Afterwards he thus writes about the protection on the Inver and Kirkaig:—

The system of protection on the Inver and Kirkaig is not efficient. The river watcher does nothing unless ordered by the Duke's factor to search the bag-nets. This order usually is known to the bag-net people as soon as an attempt is made to put it in practice.

He farther writes—

Would abolish bag-nets, or would not allow double bag-nets, one beyond the other with double leaders. I would limit the length of the leader and the distance of the bag from the shore line. I would limit also the number of nets per mile of coast. In Gruinard Bay there are 40 bag-nets. I would extend the close time. Upper proprietors are surely entitled to more than the short respite from six on Saturday night till six on Monday morning. They breed all the fish and kill the fewest of them, and yet the short weekly close time is all that is granted them. The worst feature is the killing of the spring or earliest fish by bag-nets. I would restrict the time of the opening of bag-net fishing. There is plenty of coast line for bag-nets without harrying the river mouths.

Bag-Nets and the Weekly Close Time.

With regard to the non-observance of the weekly close time by fixed nets mentioned in the above paragraph, it ought to be stated that it is, in some measure, owing to the system by which the men who work the bag-nets are paid. These men, besides their regular wages, are paid to a certain extent by results, and the more fish they catch the more money they receive. The natural and inevitable consequence of this system is to induce and encourage breaches of the weekly close time, wherever any pretence for its non-observance can be founded on stress of weather, or where the district where the bag-nets are worked is so remote and inaccessible as to be seldom visited by the river watchers. It is suggested, as a remedy for this, that the bag-nets on this part of the coast, whose fishing season at present closes on the 27th August, should close on the 27th July; and in return for having this month taken off their fishing season should be allowed to fish during the fishing season left them, without observing any weekly close time. The west coast rivers, unlike those on the east coast, are late or short-seasoned rivers; that is to say, the first clean fish do not come up until towards the end of May, and the principal fishing months are June and July. It would be a great matter if any plan could be devised whereby the constant disputes arising between river proprietors in the West Highlands and the lessees of fixed nets in and outside the sea-lochs could be put an end to. Mr Hogarth of Aberdeen, who has about 40 fishing stations, and pays upwards of £5000 a year of rent, is in favour of the above proposal, as the following extract from a letter from him will show:—

I have often thought that it would be a very desirable thing for lessees of sea coast salmon fishings, and I know it would save them many an anxious Saturday night, if an arrangement could be made by which the Saturday slap should not apply to bag-nets; that the fishing season should be curtailed, for instance, that it would be illegal to have a bag-net in the

sea before a certain date, and that they must discontinue fishing after a certain date. Some such proposal, if I mistake not, was made by a Committee of the House of Lords a few years ago. If the dates could be mutually agreed upon, I don't see why an arrangement, such as I suggest, would not work fairly well. I think, at all events, it would be worth trying for a given period—say for five years.

Mr Hogarth is quite right in stating that such a proposal was made by a Committee of the House of Lords. But it was twenty-five years ago. In 1860, a Select Committee of the House of Lords was appointed to inquire—

Whether, having regard to the rights of property of the Crown and individuals in the salmon fishings on the sea coast and in rivers and estuaries in Scotland, it is just and expedient that any, and what, legislation should take place for the regulation of such fishings, so far as regards the use or prohibition of bag-nets, stake-nets, cruives, and other fixed nets and engines, and so far as regards close times or otherwise.

The Committee, after hearing evidence which occupies 388 folio pages, reported, in the first place, that—

After giving their best consideration to the evidence submitted to them, the Committee are of opinion, that with a view to the improvement of the Salmon Fisheries in Scotland, all cruives and fixed engines, of whatever kind, both in the rivers and the sea, should be abolished; and, at all events, no new fixed engines, of any description, should be permitted to be erected.

The Committee then proceed to make certain recommendations, in the event of its not appearing practicable to enforce the above comprehensive provision with due regard to the rights of individuals. One of these provisions is—

That the annual close time be from the 20th of August until the 1st of February. Rod-fishing to continue till the 15th of October; but that no salmon, the produce of any fishing in Scotland, be sold after the 1st of September.

Then follows the provision to which Mr Hogarth alludes. It is at the end of the tenth recommendation, and is in the following terms:—

That bag-nets and stake nets be either subject to the weekly close time, or be wholly removed on the 20th July for the annual close time—that is, a month before the end of the fishing season specified in the immediately preceding recommendation.

Returns of Fish caught by Rod in Assynt District.

There are no returns of the fish taken by rods in the Assynt district. But one gentleman writes me that in 26 days he and a friend killed 39 fish in the Inver in the month of May. This, however, is an unusually good take, as the main run of fish does not enter the river till after the first flood in July. Grilse run about the same time. In Loch Assynt, from which the Inver flows, salmon, grilse, and sea-trout are to be found in summer and autumn, and they have been captured by fishing with the fly from the steep rocks between Inchnadamp Inn and Ardreck Castle, below which there is a long stretch of deep water. The Loanan, which has a course of 4 miles, and connects Loch Awe with Loch Assynt, also contains salmon and sea-trout in the latter part of the season. There is a small loch, called Loch Mulack Corrie, which lies in a hollow on the skirts of Benmore about an hour and a half's walk from Inchnadamp Inn,

which contains, probably, the most beautiful and best flavoured trout in Scotland. This loch is not a mile long, and is narrow, shallow, and weedy. It is full of fresh water shrimps, upon which the trout feed. An old inhabitant of the district told me that, nearly thirty years ago, he had taken trout of 7 lbs. weight out of this loch. At present, when Sutherland is overrun with anglers, they are scarcely ever got half that size, and they are becoming very shy. In two days' fishing, some years ago, I caught 14 weighing 13 lbs., one of them being 3 lbs. They are very deep and thick, with small heads, the belly is bright golden colour when freshly caught, and the spots are like vermillion. The flesh is a beautiful pink colour.

I was told by the innkeeper at Inchnadamph, who had been for many years a keeper in the district, that these trout never leave the loch, but spawn there about Christmas. Some have declared them to be Gillaroo trout; but the late Mr Thomas Tod Stoddart, author of *The Angler's Companion to the Rivers and Lochs of Scotland*, was of opinion that they were not the true Gillaroo; and the late Mr Stirling, of the Anatomical Museum of Edinburgh University, to whom I brought a specimen from Sutherland, was of the same opinion.

The Kirkaig.

This river forms the boundary between the parish of Assynt, in Sutherland, and that of Loch Broom, in Cromarty. It issues from Loch Fewn, and flows $3\frac{1}{2}$ miles into the head of Loch Kirkaig. About $2\frac{1}{2}$ miles from its mouth, the whole body of water in the river plunges over a perpendicular fall upwards of 50 feet in height, with steep and rugged banks both above and below. Between the deep black pool beneath this fall and the mouth of the river there are about twenty good angling pools. Heavy fish are found in these pools, a salmon of 38 lbs. and a yellow trout of 15 lbs. having been captured. The river between the head of the fall and the foot of Loch Fewn is full of fine streams and pools. But, of course, the great fall forms an insurmountable barrier to the ascent of salmon. Loch Fewn is the lowest of a chain of five lakes belonging to the basin of the Kirkaig, which stretches right across the whole breadth of Assynt into the county of Ross, through the most magnificent mountain scenery in Scotland. There is no road after you leave the path which leads up to the Falls of the Kirkaig until you reach the hamlet of Elphin, 10 miles distant, on the borders of Ross-shire. The five lochs are Loch Fewn, Loch Veattie, Cama Loch, Loch Urigill, and Loch Borrolan. The streams that run into Loch Urigill and Loch Borrolan may be considered to be the head waters of the Kirkaig, which thus traverses the whole breadth of Sutherland. If the Falls of the Kirkaig and the Black Falls between Cama Loch and Loch Veattie were made passable for fish, the whole of these lochs—with the exception of Loch Urigill—and their connecting streams, would be opened up to salmon, and the angling value of the waters in the district would be immensely increased. Next to the opening up the Falls of Tummel; the Falls of Mounessie on the Spean; and, perhaps, the Falls of the Conon and Orrin; this would be the greatest experiment in Scotland in the way of salmonising lochs and rivers at present salmonless. Probably an application of the 'Macdonald Fishway' to the Falls of the Kirkaig and the Falls at the foot of Cama Loch would be the cheapest and most effectual means of over-

coming these obstructions, if an attempt to do so is ever to be made.*

Loch Fewn is a long narrow loch, which lies beneath the range of barren reddish rocks, beyond which rise the steep sides and sharp peaks of Suilvean or the Sugar-loaf, one of the most remarkable mountains in Scotland. The loch has an area of 307·20 acres. The river which connects it with Loch Veattie, the loch immediately above, is a fine stretch of water about three-quarters of a mile long, with several good streams and pools and some excellent spawning ground. I walked twice along its whole length, and feel certain that it would afford capital salmon angling if the fish were enabled to ascend the Falls of Kirkaig. We now reach Loch Veattie, an excellent trouting loch, 4 miles long, and covering an area of about 600 acres. A short broad stream unites Loch Veattie and Cama Loch, a spacious sheet of water covering an area of 614 acres. Near the head of this stream are the Black Falls, which would form an insuperable barrier to the passage of fish. There is a long deep pool below the falls, and two fine pools between them and the foot of Cama Loch. In the lower half of Cama Loch, there are some wooded islands, in the neighbourhood of which there is capital trout fishing. The water here is comparatively shallow; but elsewhere, especially in the upper part, it is deep. A rocky peninsula divides the lake into two halves, the upper half stretching away towards the base of Suilvean. I am quite convinced that Cama Loch would afford splendid angling for salmon if they had access to it. Unless the Black Falls be blasted, or otherwise made passable for salmon, the salmonising of the great chain of lakes belonging to the basin of the Kirkaig will be left imperfect. For, even if the Falls of Kirkaig were to be made passable, this would enable salmon to ascend only into the upper Kirkaig, Loch Fewn, the stream between Loch Fewn and Loch Veattie, Loch Veattie, and a smaller loch connected with it; whereas, if the opening up of the Falls of the Kirkaig were supplemented by the much easier and less expensive operation of opening up the Black Falls; the wide expanse of Cama Loch; the Ledbeg River between Cama Loch and Loch Borrolan; Loch Borrolan itself; and the fine stretch of spawning ground in the lower part of the river that issues from Loch Urigill; would likewise be opened up to salmon and sea-trout. In the former case, 2 miles of river and 1000 acres of lochs would be made accessible for salmon; in the latter case, 7 miles of river and 1800 acres of lochs. As to Loch Urigill, an extensive sheet of water covering upwards of 500 acres, it may be left out of the question, as, on the stream which flows out of it and joins the Ledbeg River, there are three waterfalls from 12 to 15 feet high, and utterly impassable for salmon; so that it is clear that the admission of these fish into Loch Urigill would never repay the expense which would necessarily be incurred in enabling them to ascend.

The present estuary of the Kirkaig is 'a straight line drawn from 'Weather Lump on the north shore, through Big Rock, to the south 'shore.' It ought to be extended so as to be 'a straight line drawn 'from Kirkaig Point on the north, to Rhu-na-Briag on the south.' But this extension cannot take place under the existing Acts, as an

* I take this opportunity of mentioning that John Young, Esq., C.E. and architect, Tay Street, Perth, has been appointed Colonel Macdonald's agent and representative for Great Britain and Ireland; and all applications for the construction of 'Macdonald Fishways,' or inquiries concerning them, should be made to him. (See my account of the 'Macdonald Fishway,' in my Report on the Salmon Rivers of the Solway Firth and of Ayrshire, pages 98-100).

estuary line has been already fixed, and there is no power in the Secretary of State or in the Fishery Board for Scotland to make any alteration or amendment. I have indicated my opinion, and given my reasons for it, that such a power should be given in any future Salmon Fisheries Act for Scotland.—(See my Report on the Salmon Rivers on the East Coast of Scotland, from the Forth to the Kyle of Sutherland, both inclusive, pp. 56, 57.)

The whole of the net fishings belonging to the Duke of Sutherland, from the Caithness march to Cape Wrath and from Cape Wrath southwards to Lochinver, are at present leased by Mr Speedie of Perth; and, by the kindness of Mr M'Iver, the Duke's factor at Scourie, I am enabled to furnish the following state of salmon, grilse, and sea-trout taken at the bag-net stations in Assynt and Eddrachillis for the years 1873 to 1883, both inclusive :—

Year.	Salmon.		Grilse.		Sea-Trout.	
	No.	lbs.	No.	lbs.	No.	lbs.
1873	885	13,020	9,675	57,955	331	753
1874	1179	15,477	3,992	23,180	174	394
1875	1330	16,398	5,157	27,646	185	393
1876	1956	24,970	14,565	84,146	269	618
1877	2341	30,398	8,686	50,152	128	335
1878	1568	23,319	4,403	24,869	279	582
1879	478	6,690	6,405	35,695	193	405
1880	1398	17,327	5,582	32,061	190	395
1881	1562	18,530	10,087	55,599	190	397
1882	2059	24,344	6,637	36,666	332	770
1883	1897	21,267	14,595	88,524	423	1,021

The above state gives an average of about 1500 salmon and 8000 grilse taken annually by the bag-nets between Cape Wrath and Lochinver from 1873 to 1883, both inclusive. I am likewise able to give the following :—

RETURN of the RENTALS of the SALMON FISHERIES for the DISTRICT of the RIVERS KIRKAIG, INVER, LAXFORD, and INCHARD, for the Years from 1853 to 1862, and from 1875 to 1884, both inclusive.

Years.	RENTAL.		Total.
	Fishings within the Limits of Estuaries of Rivers.	Fishings outside these Limits.	
1853	£135 0 0	...	£135 0 0
1854	135 0 0	...	135 0 0
1855	135 0 0	...	135 0 0
1856	135 0 0	...	135 0 0
1857	410 0 0	...	410 0 0
1858	410 0 0	...	410 0 0
1859	305 0 0	...	305 0 0
1860	300 0 0	...	300 0 0
1861	300 0 0	...	300 0 0
1862	300 0 0	...	300 0 0
	£2565 0 0	...	£2565 0 0

RENTAL of the SALMON FISHERIES—continued.

Years.	SIMILAR RETURN.		Total.
	Fishings within the Limits of Estuaries of River.	Fishings outside these Limits.	
1875	£370 0 0	£400 0 0	£770 0 0
1876	370 0 0	400 0 0	770 0 0
1877	370 0 0	400 0 0	770 0 0
1878	395 0 0	550 0 0	945 0 0
1879	395 0 0	700 0 0	1095 0 0
1880	410 0 0	700 0 0	1110 0 0
1881	410 0 0	700 0 0	1110 0 0
1882	420 0 0	700 0 0	1120 0 0
1883	420 0 0	700 0 0	1120 0 0
1884	420 0 0	700 0 0	1120 0 0
	£3980 0 0	£5950 0 0	£9930 0 0

There are two small Hatcheries in the districts of Eddrachillis and Assynt, erected, stocked, and maintained by the Duke of Sutherland, one at Badcaul and the other at Inchnadamph. They are each capable of breeding from 40,000 to 50,000 young fish. But great difficulty has been experienced in getting a sufficient supply of ova. There seem to be numbers of male fish, but very few females.

The Land-Locked Salmon.

It seems to me that the Schoodic, Sebago, or Land-Locked salmon, might be introduced with advantage into several of the lochs in Sutherland, such as Loch Shin, Loch Assynt, Loch Laoghal, Loch Craggie, and Loch Hope, and also into Cama Loch, Loch Veattie, and Loch Fewn, the great chain of lakes above the Falls of the Kirkaig. These land-locked salmon are found in several localities in the lakes and streams of the United States and of Canada, especially in the Sebago Lake and its tributaries. They have a general resemblance in form and colour to the true salmon, or *Salmo salar*. The young fry are so closely alike that the eye fails to detect the difference, if mixed together. As they increase in growth, the reproductive functions of the males are, in both forms, active at a very early stage, while yet in what is known as the parr stage, marked externally by the presence of bright red spots and dark transverse bars or 'finger marks' on the sides. The adults have identical habits in the spawning season, and the same remarkable external changes take place in the adult males at that season of the year—the deepening of the body, the lengthening of the head, the curving of the jaws, the growth of the wonderful hooked bony process on the tip of the lower jaw, the assumption of brighter colours—though these changes are generally not quite so marked in the land-locked as in the migratory varieties. On the other hand, there are several well-marked differences between the two, and some peculiarities which favour the theory of an arrested development. For example, the dark bars on the sides, which are very prominent marks on the young fish, but entirely disappear in the adult migratory salmon, are always retained in the inner skin of the land-locked salmon, and may be

found by stripping the outer skin off; and cases of the retention of the external bars have been observed in individuals 13 inches long, though, normally, they become invisible from without when the fish is about 8 inches long. The inferior size of the land-locked salmon is accompanied by a lower rate of fecundity; but what is remarkable is, that the individual eggs of the smaller fish are of the larger size, the difference being quite noticeable, and amounting to about 20 per cent. in weight. The habits of the two forms of salmon afford the strongest contrasts. The anadromous salmon has its home in the sea, and there, almost exclusively, are its feeding grounds. It visits the fresh water for the purposes of breeding, and falls off in flesh and condition after a stay therein. Its young, on attaining the age of one or two years and a weight of a few ounces, descend to the sea to complete their growth. The land-locked salmon does not migrate to the sea, but has its home in the fresh water lakes and rivers, and instead of fasting for six months at a time, only curbs its ravenous appetite for a few weeks at the spawning season, which takes place about a week later than with the migratory salmon.

As to size, the average weight of the adult land-locked salmon of the Penobscot River, in the State of Maine, is 13 lbs. and the fish of the Sebago Lake are as large. But in most of the lakes and streams of the States they are smaller, 5 lbs. being about the average weight, though much larger individuals are occasionally met with; such as one that was found stranded and dead in Rogers Brook, in Bridgeton, in 1883, which was 30 inches long, and weighed 25 lbs. In Grand Lake stream, some hundreds were weighed in the autumn of 1883, with the result that the mean weight of the males was 3·2 lbs., and of the females 3 lbs. The land-locked salmon appear to thrive as well, other things being considered, and to attain as large a size in lakes of a few hundred acres in area as in those covering thousands of acres. For example, the largest fish in Grand Lake region are found in West Musquash Lake, the area of which is less than 1000 acres; and among new localities may be mentioned Shrewsbury Lake, in Vermont, only one mile long and half a mile wide, where signal success has attended the introduction of this fish. Depth of water appears to be of more importance than extent of area; and, as a rule, the largest salmon are found in deep lakes. Thus, among the native haunts of the land-locked salmon, Lake Sebago, where 410 feet of water have been found, contains the largest fish in the State of Maine; while West Musquash Lake, which produces the heaviest salmon of that region, is known to be, in some places, over 130 feet deep. Grand Lake is 115 feet in depth, and Shrewsbury Lake, in Vermont, 160 feet. A competent American observer states that he does not think that the land-locked salmon would thrive where they were compelled to endure through the summer a surface temperature of 70 degs. Fahrenheit or upwards. Assuredly, there need be no fear of that in any of our Scottish lakes. But, apart from temperature, these fish are not fastidious. Muddy water is certainly objectionable; but among their native haunts there are many lakes the waters of which are strongly coloured with peaty and earthy solutions. The land-locked salmon spawn on gravelly rapids in rivers and brooks. Colonel Macdonald, Fishery Commissioner for the State of Virginia, and inventor and patentee of the 'Macdonald Fishway,' told me when he was in Scotland last autumn, that he felt certain that the land-locked salmon would thrive in many of our Scotch lakes, and that impregnated eggs could be had from the United States Fish

Commission. The last Report of that Commission states that there have been distributed, during the year to which it refers, no fewer than a million and a-half of the eggs of the land-locked salmon for the purpose of stocking the rivers, lakes, and ponds of America. Loch Awe, Loch Lomond, Loch Rannoch, Loch Fannich, and many other large Scotch lakes, besides those of Sutherland, would probably be appropriate localities for the land-locked salmon. I think, however, it would be a mistake to attempt to introduce it into lakes such as Loch Naver, Loch Stack, Loch Brora, and Loch Tay, which are every season well-stocked with salmon and sea-trout.

THE SALMON RIVERS OF CAITHNESS.

There are half a dozen salmon rivers in Caithness; valuable bag-net fishings on the sea-coast; and one or two lochs frequented by salmon. But there is not a single District Board in the county, so that the enforcement of the annual and weekly close times and the prevention of poaching is left to gamekeepers employed and paid by proprietors and their lessees. It is stated in Sir John Sinclair's Statistical Account of Scotland, published during the closing decade of the last century, that 'there are six rivers in Caithness where salmon is caught—Thurso, Berriedale, Langwell, Wick, Forss, and 'Dunbeath.' Salmon are still caught in five of these. But pollutions and neglect have entirely ruined the salmon fishings in the Wick river. The following is a more particular account of the present state of the Caithness rivers.

The Berriedale and Langwell.

After leaving Sutherland, I crossed the bold promontory called the Ord of Caithness, a little to the north-east of which the Berriedale and Langwell Rivers join the sea. The Duke of Portland is the sole proprietor of these two rivers, which rise in the deer forest of Braemore and join each other 200 yards from the sea. The Berriedale has a course of 20 miles and the Langwell of 10 miles. It had been very dry weather for some time before I inspected these rivers, and they were then at their lowest. The gravel bar which stretches across the mouth of the Berriedale completely closed all access to the united streams. I walked across it almost dry shod. Not a parr could have ascended; and the only evidence of there being a river above was afforded by some tiny rills of water trickling from the bottom of the bar towards the sea. In the bend of the stream, a little way above the bar, there are abrupt rocks about 30 feet high; and it might be possible to cut a channel for the river through these rocks to the sea beyond, quite away from the gravel bar. But the operation would be expensive, and the results uncertain. Another plan would be to place a dam and sluices across a narrow rocky gorge on the Langwell River, about a mile from the sea, so as to pond up the water which might be let down in an artificial flood, and enable

fish to pass the bar. The main run of fish is in June and July. Under the existing Estuary Bye-Law, bag-nets are permitted to be placed, and are placed, within 350 yards of the mouth of the Berriedale; and there can, in my opinion, be no doubt that their being placed in such mischievous proximity inevitably and greatly deteriorates the angling in the river. From 6000 to 8000 fish are annually taken in this district by bag-nets, the greater part of the take being grilse.

The Dunbeath.

The Dunbeath River falls into the sea, after a course of 12 miles, near the village of Dunbeath, 6 miles north-east of the mouth of the Berriedale. Mr Thomson-Sinclair is the sole proprietor. There are several good pools a short way up this little river, the fall pool being the best. The spring fish run from 10 to 15 lbs.; but, in the fall pool, a salmon of 25 lbs. has been taken. About 50 salmon and grilse, on an average, are taken in the river every season. It yields also a good many sea-trout. The bag-net fishings belonging to Mr Thomson-Sinclair, in the vicinity of the mouth of the river, are let to Mr Hogarth of Aberdeen. Like most rivers belonging to a single proprietor, the Dunbeath is well managed and efficiently protected.

The Wick.

This river has a course of upwards of 20 miles, and falls into the sea at the town of Wick. It used to be a good salmon river, but the discharge into it of the whole sewage of Wick, besides dye-stuffs and other pollutions; want of watching; and general neglect, have entirely ruined the fishings. The old cruives are situated about a mile above Wick; and I was told that, fifty years ago, numbers of salmon used to be taken out of the pool below the cruiue dike by the sweep-net. The lower part of the river, from the cruives to the bridge at Wick, is very muddy and filthy at present, and would require to be cleaned out if the fishings are to be restored. About 9 miles from Wick, is the Loch of Watten, the largest sheet of water in Caithness, covering 921 acres. It is a shallow loch, nowhere above 15 feet deep, with a bottom composed chiefly of mud and marl, but also of gravel and sand and moss. There is a loch above it called Loch Scarmcleite, with which it is connected by a burn called the 'Water of Wick.' Salmon and grilse have occasionally, but rarely, been hooked by anglers in the end of the season in Loch Watten. It is famous for the quality of its trout, which average about 2 to the lb., but which have been killed as heavy as 5 lbs. The loch is connected with the Wick River by a small stream or lade supplying a mill not far from one of the best pools on the river, called the 'Mill Pool,' and by another cut or outlet which leaves the loch not far from the lade. These two join below the mill, and run into the Wick River. It might be advisable to make a direct cut from the loch to the river, starting from near a boat-house with a corrugated iron roof on the banks of the Loch of Watten, and reaching the river at the corner of a field about 15 chains east of the village of Watten. The fall from the Loch of Watten to the river, where the waste-water is discharged, is 6 feet 8 inches; and the mill is 515 yards from the sluice which regulates the outflow.

from the loch. The miller told me that, twenty years ago, he had taken 4 salmon in one day out of the Wick River, 2 of which, weighing together 25 lbs., were captured in the mill pool. He also mentioned that he had killed yellow trout in the river of 8½ lbs., and in the loch of 5 lbs. There are good angling pools and good spawning ground in the Wick River, between the bridge at Watten and the old cruive dike a mile above Wick. In the Wick River, salmon run from end of February to 1st May, grilse from end of July, and sea-trout somewhat later.

I am indebted to the Rev. Mr Gunn of Watten, who has fished the Wick for sixty years, for the following highly interesting information about the Wick River and Loch Watten, in his answers to the printed query relating to the 'Take of Fish':—

About 100 or 120 years ago, when every one could fish in any way he pleased, on a certain day in August, the people from all the surrounding districts met at the cruives on Wick River, about a mile above the town, and loaded their carts with salmon for winter use. During last season I don't suppose there were more than a score of salmon taken.

I have fished this river for more than sixty years, during all which time salmon have regularly decreased, excepting the year 1832, the year of the Reform Bill, and the first visit of the cholera; whether these affected the salmon, I can't say. Trout have diminished even to a greater extent, especially during the last ten years in Wick River, and not less so in the Loch of Watten. Fifty years ago, it was not uncommon for men to get trout of 1½ to 2 lbs. in Wick River, and about 4 lbs. in Watten Loch, and counting small and great, a basket of 4 to 6 dozen. Now, it is rare to get a trout of ½ lb. in the river, or much above 1 lb. in the loch, with a basket of half a dozen to 2 dozen. In the early period, too, our tackle was home-made and rude.

Causes of Diminution of Fish.—1. *Salmon.*—Chief cause *nets* in Wick Bay—probably also *dye-works* at Wick—and *otters*, which breed numerously about the River Wick and Loch of Watten; possibly artificial manures, largely used everywhere, may affect the fresh waters.

2. *Trout.*—All shepherds say that where sheep increase trouts diminish. Our river banks of old were pastured almost wholly by black cattle, in whose droppings, flies, &c. of all kinds bred abundantly. Now they are pastured almost wholly by sheep, in whose droppings they cannot breed. Consequently, there is not one fly on the river now for every thousand there were in old times, and the trouts are starved out of the river. To this add *sheep-washing*, numbers of *boys fishing*, &c.

The fishing in Watten Loch has doubtless been affected by diminished amount of flies and other food; also by the number of boats fishing when the weather suits, and the occasional use of the artificial otter. But the chief causes, I think, have been the wholesale capture, in ditches and small rivulets running into the loch, of spawning trout by farm servants and others; though this has been somewhat checked of late; and secondly, the havoc made among the trout, as soon as the late Duke of Portland got possession of the estate of West Watten. For two whole seasons he had his keepers fishing from boats with the artificial otter; and probably not less than from 4000 to 6000 large trout were captured, and conveyed alive in tanks of water to the River of Berriedale on another of his Grace's estates, where I am told they first ate up nearly all the salmon spawn in that small river, and then died for want of food. The Loch of Watten has never recovered the effects of these two seasons, and the subsequent occasional use of the otter by his Grace's keepers.

With regard to salmon, I should have added, that as all the arable land in this district is what is called 'furrow drained,' or 'thorough drained,' and the moors mostly sheep drained, the river floods, in time of heavy rain, came down with great rapidity and violence, sweeping away much of the salmon spawn, and often leaving it on the grassy banks. The 'spate,' that of old took three days, now takes only six or eight hours to come to its height.

The Wester River and Loch.

About 6 miles north from Wick is the Wester River, which rises in the parish of Canisbay, and, after a course of a few miles, falls into the Loch of Wester, from which, after a run of a mile further, it falls into Sinclair Bay. The loch is a mile and a-half in circumference. The river after leaving the loch winds a good deal, and is very deep much resembling the Howmore, the best fishing river in South Uist. It is said to contain good yellow trout and also heavy sea-trout in the season.

The Loch of Wester has been long celebrated for the size and excellence of its sea-trout, as we find the following account of them in the volume of Sir John Sinclair's Statistical Account of Scotland, which was published in 1794 :—'The Loch of Wester, communicating with the sea, produces plenty of excellent salmon-trout, some of them 2 feet in length, remarkable for flavour, delicacy, and richness. Hitherto they have been caught only for the use of the neighbourhood, but might become a valuable article of commerce, if their excellence was known to the luxurious citizens of London.'

It is proposed to dam up the loch, and have sluices, so as to be able to let down a spate when necessary, and thus induce salmon and sea-trout to ascend. It would not be advisable to place the dam and sluice close to the loch, as the land on each side is very low. The best place, so far as I could judge, for a dam and sluice is about 120 yards above the bridge, where the banks of the river are highest. But as there are three proprietors on the loch, they might not all agree as to the propriety of extending its area, especially as the ground around it is under cultivation.

The Thurso.

The Thurso is well known as one of the best and most productive spring salmon rivers in the United Kingdom. The whole of it belongs to one proprietor, Sir J. G. Tollemache Sinclair, Bart., Thurso Castle. But for thirty years it has been let, first to the late Mr William Dunbar, and now to his representatives. It is by far the longest and largest river in Caithness, having a drainage area of 162 square miles; while the Berriedale and Langwell, the Dunbeath, Wick, and Forss, all taken together, drain only 257 square miles. It rises in the ridge of hills that divides Caithness from Sutherland; traverses almost the whole length of the county; passes through Loch More, 20 miles from its source; and issuing from that loch runs for another 20 miles before it falls into the sea at Thurso. It is very well managed, and has long afforded first-rate angling from the 12th January, when the rod-fishing season begins, until the end of May. The bag-nets at the mouth don't begin fishing until the 1st June, which gives the river fair play, and secures an ample supply of fish to the eight rods, among which the angling is divided. After the end of March, the principal rod-fishing is in Loch More, which is about a couple of miles in circumference. Nothing but fair casting with the fly is allowed. There is said to be a high fall above Loch More, which prevents the ascent of salmon to 6 miles of good spawning ground. When I was inspecting the Thurso, Mrs Dunbar, and her daughter Mrs Sutherland, complained of the injury done to the river by sheep-washing. They stated that in the months of June and July last (15th June to 15th July) 1300 sheep had been washed, to the great injury of the fry in the river.

The Thurso has long been famous for its abundance of salmon, and it is said that at one time salmon to the value of £1610 were annually barrelled and exported from Thurso. It is stated in Sir John Sinclair's Statistical Account of Scotland, that the River Thurso frequently yielded from 150 to 200 barrels of salmon in a year, and that it is a well attested fact that, about the middle of last century, 2560 salmon were taken in a single haul of the net from one pool in the river.*

At that time, the salmon fishing in the Thurso commenced in November and ended in August. The greater part of the fish taken were boiled and kitted, and conveyed on board smacks to London. There was no preservation of kelts in those days, as we are informed that 1200 have been sent from the Thurso in a year, and the general average was from 700 to 800 in a season.

The greatest number and weight of fish killed by the rod in the Thurso since 1853, was in 1863, when 1510 fish, weighing 14,777½ lbs., were captured; and the next best year was 1874, when 1240 fish, weighing 13,870 lbs., were taken. The smallest number was in 1881, when only 236 fish, weighing 2830½ lbs., were killed.

Mrs Dunbar has kindly supplied me with the following interesting tables of the number of salmon taken by the rod on the Thurso, in each year from 1853 to 1882, both inclusive. From these tables it appears that, in thirty years, 19,112 fish, weighing 202,499½ lbs., or upwards of 90 tons, were killed with rod and fly on the Thurso during the first five months of the year. The last ten years, however, show rather a falling off, when contrasted with the ten years immediately preceding; 7378 fish, weighing 75,115 lbs., having been killed from 1863 to 1872, both inclusive; and only 6112 fish, weighing 71,003 lbs., having been killed from 1873 to 1882, both inclusive. It is gratifying, however, to see that the average weight of the salmon has been steadily increasing, attaining, for the last period of five years, the very good average of 11·83 lbs. During the period of thirty years over which these tables extend, one rod has once killed 21 salmon in a day; 17 have been three times killed in a day; 15, twice; 14, once; 13, seven times; 12, eight times; 11, twenty-one times; 10, twenty-four times; 9, twenty-eight times; 8, fifty-four times; and 7, seventy-three times. The Helmsdale and the Thurso are excellent examples of the happy results which follow from striking a fair balance between rods and nets. In the former case, the nets do not begin until 1st May

* The following particulars of this extraordinary fishing are taken from Appendix No. III. to the 'Statistical Account':—'In the preceding statistical account (cap. 2, section 1), mention is made of the celebrated draught of salmon in the river Thurso, when no fewer than 2560 were caught. In order to have the fact ascertained, the following certificate was given by three persons of unquestioned veracity, who witnessed the transaction:—"*THURSO, 23rd August 1792.*—Mr George Paterson, now Baillie of Thurso, George Swanson, shoemaker there, and Donald Finlayson, senior, fisher there, do hereby certify and declare, that upon the 23rd day of July, old style, we think in the year 1743 or 1744, there were caught at one haul, in the Cruive Pool, upon the water above the town of Thurso, 2560 salmon. These fish were caught by a large net, beginning the sweep at the Cruives, and coming down the stream to a stem at the low end of the pool. The net was carried down the water by about 18 or 20 men with long poles in their hands keeping down the ground rope, and the fish were afterwards taken ashore by dozens in a smaller net. Each man got a fish and some whisky for his trouble. We farther personally certify and declare that we were personally present when these fish were caught. (Signed) George Paterson, George Swanson, Duncan D. F. Finlayson."

The next greatest haul to the above that I have heard of in Scotland was taken, in 1648, out of the Sluie Pool in the river Findhorn, where 1300 salmon were netted in one night; 540 being taken at a single draught. (See my Report on the Salmon Rivers on the East Coast of Scotland, page 29).

and in the latter until 1st June. The spring fish have thus free access to the rivers; then, in the middle of the season, the nets commence and make a very good thing of it, as is shown by the fact that, in 1876, the nets in the Helmsdale District took 5116 lbs. weight of salmon and 22,167 lbs. weight of grilse.

THURSO.

Number of Fish Killed in each Year.

Average Weight 10·21 lbs.

Year.	Fish.	Weight.
1853	356	3,654 lbs.
1854	379	3,907 "
1855	954	9,674 "
1856	358	3,615 "
1857	426	4,410 "
Total	2473	25,260 "

Average Weight 9·88 lbs.

Year.	Fish.	Weight.
1858	411	4,013 lbs.
1859	658	6,611 "
1860	1041	10,132 "
1861	544	5,544 "
1862	495	4,821 "
Total	3149	31,121 "

Until about 1857 there were fewer rods; after that time seven rods; from 1870 eight rods.

In 1858 the Loch and Beats 7 and 8 were let separately, and the fish killed on them are not included in the Log Book.

Year.	January.	Feby.	March.	April.	May.	Total.	Weight.
1863	...	206	317	290	697	1510	1,466½
1864	...	16	157	259	128	560	5,344
1865	...	34	132	203	83	452	4,397
1866	...	20	124	109	78	331	3,298
1867	...	75	68	207	371	721	7,301½
Total	...	351	798	1068	1357	3574	35,007

Average Weight 9·79 lbs.

Year.	January.	Feby.	March.	April.	May.	Total.	Weight.
1868	...	100	244	490	178	1012	9,651
1869	...	91	150	240	236	717	7,306½
1870	8	70	217	317	275	887	9,679½
1871	1	33	83	192	131	440	4,777
1872	4	62	125	246	311	748	8,694
Total	13	356	819	1485	1131	3804	40,108

Average Weight 10·54 lbs.

Year.	January.	Feby.	March	April.	May.	Total.	Weight.
1873	9	22	98	268	210	607	7,922
1874	11	47	80	636	466	1240	13,870
1875	7	71	225	257	30	590	6,662½
1876	16	28	88	245	166	543	6,408½
1877	7	66	230	191	246	740	7,833½
Total	50	234	721	1597	1118	3720	42,696½

Average Weight 11·47 lbs.

Year.	January.	Feby.	March.	April.	May.	Total.	Weight.
1878	16	79	160	405	98	758	9,911½
1879	2	5	54	146	97	304	3,720½
1880	19	30	154	178	84	465	5,407½
1881	...	7	37	136	56	236	2,830½
1882	8	41	104	292	185	629	6,437
Total	45	162	509	1157	520	2392	28,307

Average Weight 11·83 lbs.

Average Number of Fish per Month.

Year.	January.	February.	March.	April.	May.
1863-67	...	70	159	213	271
1868-72	...	74	164	297	226
1873-77	10	47	144	319	223
1878-82	9	32	102	231	104

In the earlier years, January and February are reckoned together.

There used to be for many years a salmon hatchery on a considerable scale at Brawl Castle. But like the Duke of Sutherland's hatchery on the banks of Loch Brora, it has been given up, and there has been no artificial propagation of salmon for five years.

The Forss.

The Forss is 15 miles in length, and falls into the North Sea 6 miles to the west of Thurso. There are several lochs connected with its basin, the chief of which is Loch Shurary, about 8 miles from the sea, to which salmon, grilse, and sea-trout ascend in the season. The Forss is an early river, grilse having been caught last year on the 7th and 11th April. The fishing has greatly improved during the last few years. In 1882, the keeper had 46 salmon to his own rod in six days' fishing, the largest number in one day being 11 fish; and, at

the time of my visit on the 21st of last June, he had killed 57 fish. There is a hatchery on a burn which runs into the Forss, which has been in operation for about seven years, and the keeper, Macnicoll, told me that he thought the effect of the artificial breeding of salmon had been greatly to improve the angling in the river. He stated that, before the hatchery was established, the highest take by the rod was from 50 to 60 fish in a year. Now, the take has risen to 200. He also stated that he thinks that one effect of artificial breeding has been to make the river earlier; and he mentioned that several of the smolts artificially hatched out had been marked with platinum wire on the dead fin, and some of them were got afterwards as salmon in the nets near John O'Groat's House, about 25 miles to the eastward of the mouth of the Forss. The hatchery is supplied with spring water filtered through perforated zinc and charcoal. Macnicoll has shown great ingenuity and thoughtfulness in the way he has managed this hatchery, and in the precautions he has adopted to prevent the destruction of the fry he puts into the burn close to the hatchery, and afterwards allows to go down into the main river. In general, when such fry are put at once into a river, without any precautions being adopted, they merely serve to feed the yellow trout and eels. But, in this case, the hatchery is close to the bank of a small burn which runs into the Forss about a mile further down. Before putting in the fry, this burn was dammed back, so that between the dam and the Forss its bed was almost dry, and all the trout and eels, to the number of a great many dozen, were taken out of it before the fry were put in, so that, by the destruction of their natural enemies, they were given a fair chance of thriving and growing. The mouth of this burn is closed to a certain extent, by an apparatus resembling a cruive-box, which prevents yellow trout from the Forss getting into the burn, and captures them when they make the attempt. At the same time, the salmon fry, when inclined to leave the burn and go down to the river, are able to do so through the small meshes of a wire screen which forms the back of the box or cruive, and prevents the ascent of yellow trout. This screen is so constructed as to be capable of removal at pleasure, in order to be cleaned from weeds and other obstructions. The hatchery measures 10 feet by 10, and the average number of fry hatched out is 200,000. But one year 250,000 were hatched, and 240,000 fry turned into the Forss.

There are several good salmon pools on the Forss, both above and below Westfield Bridge; and about a mile from the sea there is a fall immediately below Forss House, which supplies a mill. There is an interval of at least 25 feet between the water above the fall and the pool below. But the fall is so broken that fish have no difficulty in ascending when the river is in such a state as to induce them to run. Between the fall and the sea, the Forss is comparatively deep and still, and affords capital angling when the river is in good ply and there is a strong breeze. In Loch Shurary, from which the Forss flows, salmon have been frequently taken with the fly. There is much good spawning ground above that loch. At present, the fishing season on the Forss does not begin until the 11th February; but I agree with the keeper in thinking that, while the netting season should be left as it is, the angling season should be made the same as that on the Thurso, the salmon river immediately to the east, and on the Halladale, Strathie, Naver, Borgia, and Hope, the five salmon rivers immediately to the west of it; that is to say, the rod fishing season should be from 12th January to 10th September.

THE SALMON RIVERS ON THE WEST COAST OF ROSS AND CROMARTY.

The Polly.

The northernmost salmon river in the county of Cromarty is a small stream called the Polly, which belongs to the Duchess of Sutherland. There are no fewer than eleven lochs belonging to the basin of the Polly, one of which—Loch Skin-a-skink—is nearly 15 miles in circumference. The Polly flows through three lochs after its exit from its great reservoir Loch Skin-a-skink, and it has a winding course of 2 miles from the lowest loch from which it issues, to the sea at Inverpolly. When I first inspected it in 1878, I found that the ascent of salmon to this extensive series of lochs was entirely barred by waterfalls in the course of the Polly. There are two falls about a mile and a half from the mouth of the river, a little way below the loch next to the sea. Immediately above these falls, the river divides into two branches, the larger passing over the falls, and the smaller running through a narrow channel, with a comparatively easy gradient and joining the main stream beneath the lower fall. I then recommended that this channel should be enlarged and deepened, and the main body of the stream diverted into it, which would soon widen the passage for itself, so as to enable salmon and sea-trout to surmount the falls. This has since been done by the lessee of the fishings and shootings, and when I inspected the Polly last summer the keeper informed me that the experiment had been attended with success, and that salmon can now get over the lowermost falls and so pass into the loch nearest the sea. Sea-trout up to 3 lbs. weight have been caught in it, and salmon have been more than once raised but not captured. The river below these falls has been much improved since my visit in 1878, several new pools having been formed and existing pools improved. The opening up of these falls is, however, only the first step towards salmonising the lochs in the basin of the Polly; as above the lowest loch, and on the stream between it and the second loch, there are falls much more difficult to overcome, but, the opening up of which would turn the nine lochs above and their connecting streams from mere trouting waters into salmon waters, and would thus immensely increase their importance and value. These falls are about 24 feet in height, the river at the time I saw it being extremely low, at least 2 feet below fishing trim. It occurred to me that by carrying from the stream above to the pool below, along either of the perpendicular sides of the rock below the fall, wooden troughs, in successive steps, supported on iron struts fixed into the rock, it might be possible to enable salmon to surmount this obstacle without incurring very great expense; and I feel certain that Colonel Macdonald could put up one of his fishways for a sum not exceeding £500. Above this fall there are two lochs, one about a mile, and the other about 3 miles in circumference; and then comes the wide expanse of Loch Skin-a-skink, covering 1638·40 acres, connected with which by various streams are seven other lochs, the largest of which is Loch Achyle, between Loch Fewn and Loch Skin-a-skink. The head of Loch Achyle is less than half a mile from Loch Fewn, and its lower extremity is within about the same distance of Loch Skin-a-skink, so that the lochs belonging to the basin of the Kirkaig and these

belonging to the basin of the Polly are brought very close together. In Black's map of Scotland and in the map given with the *Sportsman's Guide*, a river is marked as running from the head of Loch Achyle into Loch Fewn. But this is a mistake, as I ascertained by careful personal inspection that there is no connection whatever between the two lochs.

The trouting in Loch Skin-a-Skink is excellent, and it contains an unusual number of large trout. I once killed one 6 lbs weight, and a friend who was with me in the boat at the time shortly afterwards captured one of 12 lbs. The same gentleman, in 1878, took 18 trout in one day in Loch Skin-a-skink, weighing 36 lbs. They were all caught by trolling with large-sized phantom minnows. Between the lower falls and the sea there is some good spawning ground on the Polly. In a very good year, such as 1883, between 40 and 50 salmon and grilse have been taken in the Polly.

The Kennart, Ullapool, and Broom.

Two small rivers, the Kennart and the Ullapool, both belonging, like the Polly, to the Duchess of Sutherland, are next met with. The fishing in both has greatly fallen off since the establishment of bag-nets near their mouths. One gentleman, well acquainted with these rivers, writes me that, thirty years ago, he has sometimes caught from 10 to 12 salmon in a day in the Ullapool, a thing utterly unheard of now. The Broom and the Ullapool have the same estuary line, namely, 'a straight line drawn from Ru-na-Caddal on the north 'to Ru-Camas Voarach on the south.' I humbly venture to think that the Kennart, as regards estuary, should be united with the Broom and the Ullapool, and that the estuary line for the three combined rivers should be 'a straight line drawn from Rudha Dubh Ard 'on the north to Cailleach Head on the south.'

The Broom rises among the Dirrie mountains, its two head streams issuing from two lochs 6 miles apart, called Loch Droma and Loch-a-Bhraoin; and after the junction of these two streams it has a course of $4\frac{1}{2}$ miles, and then falls into the head of Loch Broom about 7 miles from the village of Ullapool. The most easterly branch of the river flows for nearly a mile, through a magnificent rift or cañon in the rocks. The walls of this chasm are perpendicular, and about 200 feet in height; and, near the top of it, the river falls in one leap 180 feet. From the foot of this fall to the sea the distance is between 5 and 6 miles. From the Linn below the falls, on the other branch of the Broom, which joins the Loch Droma branch near the foot of the chasm, the distance to the sea is nearly the same. There are about twenty good salmon pools on the river, mostly natural, but some of them artificial, constructed with great skill and judgment. In fact, everything that money and skill could do to improve this river has been done; yet it does not produce one tithe of the fish that it used to yield before the bays near its mouth were studded with bag-nets. The river belongs to Mr Fowler of Braemore, whose son informs me that from 50 to 60 fish has been the outside of the annual catch for a long period of years. And a gentleman who has been well acquainted with the Broom for sixty years writes me as follows:—

When I began fishing in the river Broom in early days, there was no restriction. Every one fished both with rod and spear. The rivers were

swarming with fish; and on the Broom, when in good trim, I could get from 8 to 12 fish in a day with the rod. I have taken with the spear 60 in one day, and could have got more. This would be about 1820. On the Ullapool river, I have sometimes got from 10 to 12 salmon in a day. I have not the least doubt that the bag-nets are the sole cause of the scarcity of fish in the rivers here, along with poaching with trawls on the coast at night.

Mr J. A. Fowler of Inverbroom writes as follows, in answer to the printed queries :—

The take of fish is gradually diminishing. Sea-trout have almost disappeared. I impute this to seining or trawling off the mouths of rivers by crews with long seine nets with a small mesh, about 3 to 4 inches round each mesh, or about $\frac{3}{4}$ ths of an inch from knot to knot. Several crews from Ullapool and district fish regularly during June, July, and August near the mouths of the Broom and Ullapool rivers. When prosecuted, their defence is that they are fishing for herrings, cuddies, or white fish. Thirty years ago 8 to 10 fish to a rod in one day was not uncommon. Now about 50 to 55 fish are killed on the Broom in a year and about 10 or 12 sea-trout. Bag-nets have enormously diminished the supply of fish to this coast. The bye-laws regulating the observance of the weekly close time by stake and bag-nets are only fairly well observed. The penalties should be much more severe.

With regard to the weekly close time, Mr Fowler makes the following suggestion :—

The weekly close time is not sufficient. It should be increased to 60 hours, instead of as at present 36,—say, from 6 p.m. on Friday night to 6 a.m. on Monday morning. Or, perhaps, the weekly close time should be kept as at present, but there should be, say a fortnight's close time during the grilse run. The date of this close time might be fixed at varying dates for different rivers, according to the date of the grilse run. Probably 15th June to 1st July would suit the majority of the rivers on the west coast.

There is no District Board for the Polly, Kennart, Ullapool, or Broom. The rivers are watched and protected by the keepers of the Duchess of Sutherland and Mr Fowler of Braemore. And here it should be mentioned that there is no District Board on any of the salmon rivers on the west coast of Ross-shire. The reason of this is not apathy on the part of the proprietors, so much as the fact that all these rivers are small rivers, and the Fishery Districts attached to them cannot support the expense of a District Board. If, however, three, four, or more of the rivers adjacent to each other were combined into one Fishery District, they might be worked by one Board and one clerk, and the assessment raised from the combined district, including of course the sea-nets, which at present contribute nothing to the protection of the rivers, might be sufficient to pay expenses.

I am informed that the bag-nets in the Broom District are let for £350 a year.

The Meikle Gruinard and the Little Gruinard.

These are two very out-of-the-way rivers, and I had to inspect them by boat. They both fall into Gruinard Bay; the Meikle Gruinard flowing out of Loch-na-Shallag, and falling into the sea after a course of nearly 6 miles, and the Little Gruinard issuing from the Fionn Loch, and joining Loch Gruinard, after running $5\frac{1}{2}$ miles in a north-easterly direction. Gruinard Bay is 5 miles across from Stattic Point

to Ru More, and $4\frac{1}{2}$ miles deep to its southernmost recess. There are between thirty and forty bag-nets along its shores. The present estuary line is much too contracted, cutting nearly across the mouth of the Meikle Gruinard at low water. It ought, in my opinion, to be extended, and a line drawn across the bay immediately outside Gruinard Island. Last year, three first-rate anglers between the 15th June and the 15th July, about the very best month in the year, captured only 2 salmon and 5 grilse in the Meikle Gruinard. Yet Mr Bateson, at present lessee of fishings and shootings at Shieldag, Gairloch, told me that, fifteen years ago, he killed 21 salmon and grilse in a single day in a single pool, known as the Craig Pool, in the Meikle Gruinard ; and Mr Murray, who has been for twelve years lessee of the fishings and shootings in and around the Meikle Gruinard, states that he has frequently captured 12 fish in a day eight years ago ; and that Major Duff, the previous lessee, has killed as many as 500 salmon and grilse to his own rod in a single year. Now, however, the fishing is steadily falling off year by year, which he imputes to the number of bag-nets in Gruinard Bay, and their too close proximity to the mouth of the river.

The Ewe.

This beautiful river has greatly fallen off since Sir Humphrey Davy wrote about it in his *Salmonia*, nearly sixty years ago. He thus speaks of it—

If you could have seen this river twenty years ago, when the cruives were a mile higher up, then you might have enjoyed fishing. There were eight or ten pools of the finest character possible for angling, where a fisherman of my acquaintance has hooked 30 fish in a morning. The river was then perfect, and it might easily be brought again into the same state ; but, even as it is now with this single good pool, and this second tolerable one, I know no place where I could in the summer months be so secure of sport as here—certainly nowhere in Great Britain.

Mr Thomas Tod Stoddart too, in his *Angler's Companion to the Rivers and Lochs of Scotland*, published in 1847, gives a vivid description of the former excellence of the angling in the Ewe :—

It was quite of common occurrence [he writes] for the late Sir Kenneth Mackenzie, grandfather of the present proprietor, to capture 20 fish and upwards in the course of a day, all of them new run salmon and grilse. Many of the salmon taken with the rod in this river are of great weight, exceeding 30 lbs., and they afford sport, that one accustomed to kelt fishing has little idea of, frequently unwinding at a single burst from 60 to 90 yards of line. The sea-trout angling in July is incomparable, and by many preferred to the nobler amusement. On a favourable day these fish may be raised at every cast.

The Ewe flows out of Loch Maree, a magnificent sheet of water, 18 miles long and 3 miles wide in the broadest part, and thence it runs for $3\frac{1}{2}$ miles in a westerly direction in a broad and rapid current, until it falls into the head of Loch Ewe. From an old fishing book which has been preserved, we get some account of the fishings in this short but productive river in the earlier years of the present century. In 1806, the tacksman began his fishing on 19th February, when 9 fish were captured. The next entry is March 1st, after which the takes were as follows :—March, 71 salmon ; April, 99 ; May, 144 ; June, 189 ; July, 113 ; August (to 27th), 58 ; total, 682 salmon, weighing 5990 lbs., or an average of scarcely 8 lbs. each. Grilse fishing com-

menced on June 20, and terminated August 27, the last twenty days of it being the most prolific. The total catch of grilse was 1412, weighing 5076 lbs., or less than 4 lbs. each. In 1806, there were also a number of splendid sea-trout taken, namely 579, weighing no less than 1843 lbs., or an average of 3 lbs. each. They were chiefly captured between 23rd July and 13th August. In 1820, the fishing began 14th January and continued until 28th August, when 415 salmon were killed and 2727 grilse. The weight of the fish is not given. Only 37 sea-trout were taken in that year, between the 2nd and 10th July. The wages bill for that year amounted to £25, 18s., besides £2 paid to George Mitchell as 'expenses for his *vitals*,' and £3, 10s. for 'whiskee for the concern.'

The upper part of the Ewe has all the characteristics of a lacustrine river, broad, deep, and still, in some places from 100 to 200 yards across; but the lower half is a beautiful combination of streams and pools. There is a fine pool below the old cruive, and a couple of pools between that and the sea-pool, also a grand pool at a bend of the river above the cruives. Altogether, I counted about a dozen pools between the still water and the sea. The finest pool in the Ewe seemed to me the uppermost circular pool at the bend just below the still water.

The fishing in the Ewe is far inferior to what it used to be in the earlier days above alluded to. Mr John Dixon, Inveran, who has been acquainted with it for ten years, writes—

During the ten years I have known the Ewe, I don't think the take of fish by rod has averaged more than 40 salmon per annum. Notwithstanding the recurrence of a good season like 1883, I do believe that the stake and bag-nets are gradually but surely diminishing the stock of salmon, and I have no doubt, sooner or later, the weekly close time must be extended. I do not think that the bye-laws are duly observed; there is no one to see that they are; I think Government ought to provide some inspection. No doubt, stake-nets and bag-nets are necessary for the supply of the market. A longer weekly close time, and better inspection to secure its observance, are what is really wanted. If the weekly close time were increased, and still more important, if there were proper inspection to see that the bye-laws were observed, the Ewe would be as good an angling river as it is said to have been before the nets were put in.

Elsewhere he writes regarding the run of fish in the Ewe :—

I have no doubt there is a small run of salmon in the winter (December and January). I have killed fish in February that had been a little time in the river, possibly seven or eight weeks. Formerly, the Chief of Gairloch always had a fresh run fish for his New Year's dinner. Another small run takes place in March, and another at the end of April and beginning of May. The principal run is no doubt in June and July, and the grilse come at the same time. There is also a large run in October.

Another gentleman, in his answers to the printed queries, writes as follows with regard to the bag-nets and the weekly close time :—

Weekly close time should be from noon on Saturday till noon on Monday. In bad weather the bag-net fishermen say they are sometimes unable to close nets at all on Saturday evenings. If they had to close at noon, they would have less excuse. The great difficulty on the west coast is to get nets looked after on Sundays; whereas, if obliged to be closed on Saturday, there would be no difficulty. In the Ewe, rod-fishing was better last year (1883), than it has been for the ten previous years, but only a moiety of what it used to be.

The Badachro and Kerry.

From Poolewe I drove to Gairloch Hotel, and inspected the rivers Kerry and Badachro, both of which fall into Gairloch not far from Shieldag. The fishing of these rivers has terribly fallen off of late years, and from the same cause previously indicated, namely, the too great nearness and the too great numbers of bag-nets outside their mouths. The present estuary line of the Badachro and Kerry is 'a straight line drawn from the north-westerly point of Stron-na-ard on the east shore, touching the outer end of Eilean Horrisdale, to the mainland west.' But this line is 3 miles within Gairloch, whose outer limits are from Ru Bane on the north to Carr Point on the south; and bag-nets set so far within the loch naturally intercept the salmon swimming along the shores on their way to the rivers. I venture to think that a fairer estuary would be a straight line drawn from the mouth of the river Sand to Sron-a-Carra. In fact, unless the weekly close time is considerably increased, or the estuary line extended as above suggested, I don't think there is much chance of any improvement in the fishing in the rivers which is now almost ruined.

In the answers to the printed queries, I find the following from the Badachro and Kerry Districts :—

The weekly close time is not satisfactory. For more than twenty years I have thought it should be from midday on Saturday until midday on Monday. The observance would be more under the eye of the public. The excuse of *weather* and the *Sabbath* would not hold good.

The same gentleman writes as to the observance of the weekly close time :—

In my district there are only bag-nets, and the weekly close time has not been strictly observed. On the west coast, which is so much indented, I consider 2 miles from a river's mouth quite near enough for a bag-net. In fact, nothing but a jubilee would restore to the rivers anything like a catch of fish. The net fishermen crowd on additional bag-nets whenever dry weather or the time of the year makes such likely to pay. I have seen and counted in 1883, 13 nets within one mile of sea-coast. The Badachro River would be greatly improved if the fish could get over two falls close together about 2½ miles from the mouth. This could be effected best by building up the pools below the falls, *i.e.*, by blasting and tumbling in the rocks above each of the pools and raising the water, so that the falls, which are now about 19 feet high, would be diminished to 5 feet or so. But, under present conditions of so many bag-nets, it would not pay either proprietor or tenants to carry this out, although there are several miles (including lochs) of good spawning ground above.

Another gentleman writes—

The salmon fishing on the rivers on the coast has fallen off to such a degree that rivers which used, even twenty years ago, to produce hundreds of fish to the rod in a single season, do not now produce a score of fish.

One of the oldest lessees in the district of the Kerry and Badachro, who has been nearly twenty-five years in that locality, writes as follows :—

I am very strongly of opinion that the weekly close time is too short, and that it should be extended. It should commence and end at midday. The take of salmon and grilse at Gairloch has fallen off very greatly within the memory of those who have lived forty years in the district. I can from my own knowledge testify to the decrease within the latter period. Grilse are

now seldom seen or taken in the Kerry or Badachro Rivers, owing to the number of bag-nets, the shortness of the weekly close time, and the entire absence of any control over those who should observe it. From my own personal knowledge, I can speak of another very serious evil which of late years has grown apace. Yachts have greatly increased in number. They come about the west coast during the months of June, July, and August, and their crews, sometimes under the direction of the owner or hirer himself, sometimes without his knowledge, drag the mouths of the rivers at night, carrying off those fish that have escaped the bag-nets. Before morning the yacht has generally disappeared. It is very difficult to stop these depredators who come with more boats than one, and although I and my gamekeepers frequently watch the night through and occasionally catch them in the act, yet many escape in the dark nights, having cleared out, if the season is dry, nearly the whole river's supply of fish which were waiting at the mouth for a spate to ascend. I regret to say that it sometimes happens that, after having been warned off, and having promised not to repeat the offence, the same yacht's crew have again made another attempt during the same night.

Illegal Fishing
for Salmon and
Sea-trout by
Yachtsmen.

This is by no means the first time that this illegal fishing for salmon and sea-trout by yachtsmen has been complained of; for so far back as February 1874, I drew up a Circular, which was signed by the Commissioners of Scotch Salmon Fisheries, and sent to the secretaries of all the Yacht Clubs in the United Kingdom. That Circular narrated the law applicable to the subject, and concluded by stating that the Commissioners had the authority of the Home Office for drawing it up and sending it to the Secretaries of the various Yacht Clubs in the United Kingdom, with a request that they would take an early opportunity of bringing it prominently under the notice of their members.

This circular, however, did not produce the desired effect, as complaints of illegal fishing by yachtsmen were made to the Fishery Board for Scotland, who have succeeded to the powers and duties of Commissioners of Scotch Salmon Fisheries, and have the general superintendence of the Salmon Fisheries in Scotland, and the following Circular, signed by the secretary to the Board, was sent to the Secretary of every Yacht Club in the country, and also to a number of newspapers:—

Scottish Salmon Fisheries.—Fishery Board for Scotland, Edinburgh, 31st May 1884.—SIR, I am directed by the Fishery Board for Scotland to inform you that the Inspector of Salmon Fisheries has laid before the Board complaints from lessees of salmon fishings, that yachtsmen, while cruising along the coasts of Scotland, and especially along the coasts of the western mainland and the Hebrides, are in the habit of using nets, and illegally taking salmon and sea-trout, within the limits from low water mark, over which the rights of the Crown and its grantees extend.

According to the law of Scotland, no one has a right to fish for salmon or sea-trout in the narrow or territorial seas—which are held by the best legal authorities to extend to three miles seawards from low-water mark—except the Crown and its grantees and those who have permission from them; and by special Statute (7 & 8 Vict. c. 95), it is provided that: “Whereas an Act was passed in the ninth year of the reign of His Majesty King George the Fourth, intituled, An Act for the preservation of the salmon fisheries in Scotland; and whereas it is expedient to prevent the destruction of salmon, or fish of the salmon kind, in the sea or shores thereof; and whereas doubts are entertained of the provisions of the said Act being applicable to the sea or sea-shore: Be it therefore enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal and Commons in this present Parliament assembled, and by the authority of the same, as follows: That if any person not having a legal right or permission from the proprietor of the salmon fishery, shall, from and after the

"passing of this Act, wilfully take, fish for, or attempt to take, or aid and assist in taking, fishing for, or attempting to take, in or from any river, stream, lake, water, estuary, frith, sea-loch, creek, bay, or shore of the sea, or in or upon any part of the sea, within one mile of low-water mark, in Scotland, any salmon, grilse, sea-trout, whitling, or other fish, of the salmon kind, such person shall forfeit and pay a sum not less than Ten Shillings and not exceeding Five Pounds, for each and every such offence, and shall, if the sheriff or justices shall think proper, over and above, forfeit each and every fish so taken, and each and every boat, boat tackle, net, or other engine used in taking, fishing for, or attempting to take fish as aforesaid; and it shall be lawful for any person employed in the execution of this Act to seize and detain all fish so taken, and all boats, tackle, nets, and other engines so used, and to give information to the sheriff or any justice of the peace, and such sheriff or justice may give such orders concerning the immediate disposal of the same as may be necessary."

"The above statute has since been amended and made more stringent by the 25th section of "The Salmon Fisheries (Scotland) Act, 1868," which provides that, "In order the better to carry out the provisions of the Act of the seventh and eighth years of her present Majesty, chapter ninety-five, it shall be lawful for any water-bailiff, constable, watcher, or officer of any District Board, or any police officer, to search all boats, boat tackle, nets, or other engines, and all receptacles, whether at sea or on shore, which he or they may have reason to suspect may contain salmon captured in contravention of the said last-mentioned Act, and to seize all salmon found in the possession of persons not having a right to fish salmon, and the possession of such salmon shall be held *prima facie* evidence of the purpose of the possessor to contravene the provisions of the said last-mentioned Act."

"From the foregoing statement you will at once see, that all yachtsmen who have neither a title to salmon fishings nor permission from one who has a title, but who, notwithstanding, fish for or take salmon, grilse, or sea-trout, in the narrow seas around the coast of Scotland, within the limits over which the rights of the Crown and its grantees extend, infringe the law and render themselves liable to prosecution and punishment."

"The Fishery Board for Scotland, established by the Fishery Board (Scotland) Act, 1882, has now the general superintendence of the salmon fisheries in Scotland, and I am instructed to request that you will be so good as to take an early opportunity of bringing this matter prominently under the special notice of the members of your club.—I am, your obedient servant, DUGALD GRAHAM, Secretary."

"To the Secretary of Yacht Club."

When it is considered that there are 58 Yacht Clubs and upwards of 4300 yachts in the United Kingdom, and that the west coast of Scotland and the Hebrides are the most favourite cruising grounds in summer, it will be generally admitted that these circulars were not uncalled for.

On the 15th of last July, I inspected the Kerry. About 3 miles from its junction with the sea, there is a lofty fall or rather series of falls; and about 150 yards below the main fall a smaller fall which must to some extent obstruct, though it does not prevent, the upward progress of salmon. The main falls are entirely impassable; the river was very low when I saw them, and they were then broken up into five separate cascades. The lowest fall was about 10 feet high; but at a narrow point on the left bank of the river, about 50 yards below, where there is a huge round boulder immediately below a small birch tree, it would be easy to form a subsidiary dam, 4 or 5 feet high, which would raise the water to that extent on the face of the lowest fall, create a long and fine pool, and enable the fish to ascend by two comparatively easy jumps, instead of the present impracticable single jump. It would also be necessary to blast the third fall and top

of the fourth, and likewise to make a passage on the left side of the uppermost fall, which forms a complete obstruction at present, being 7 or 8 feet high, and not only perpendicular but overhanging, the rock being hollowed out beneath the edge or lip of the fall. On the whole, however, I think it very doubtful whether it would be worth while going to the expense which would be incurred before the falls of the Kerry could be made accessible to salmon, though there is some good spawning ground in the mile of river above the falls, and a series of six good pools close together a little way above them. The trout in this part of the river, according to the Flowerdale keeper, are large, fat, and of very good quality. They cut pink, and run to a pound weight. The river above the falls flows out of a loch called Bad-an-Scalaig, about a mile long and half a mile wide, with a fine clean, stony bottom, and not deep. The trout in it are got as heavy as 2 lbs. weight. Above this loch is another mile of river, with good spawning ground and angling pools, and then a second loch. Altogether, there are six or seven lochs, most of them small, connected with the basin of the Kerry.

The mouth of the Kerry, where it enters the head of Gairloch, is very narrow, and is shut in by two ridges of rocks. Below these rocks there is a deep pool into which the tide flows; and then a beautiful gravelly bay, a choice place for poaching from yachts, and which has repeatedly, as I was informed, suffered from their depredations. It has now had stones placed in it, armed with iron hooks, in order to prevent illegal netting.

Next day I inspected the falls on the Badachro, which are about 2 miles from Sheildag Lodge. These consist of a lower fall, 8 or 9 feet high, which might easily be opened up by forming a subsidiary dam, for which the materials lie close at hand; then comes, some 300 yards or more higher up, a fall of 18 or 20 feet, the fall on the left bank being quite perpendicular, while that on the right bank is more broken and sloping. The sides of the stream for some distance below the fall are quite perpendicular, and in the chasm between them is a long, dark, deep pool. A resting pool should be excavated on the right bank, at the first jump, a few feet above the fall pool, and a second resting pool should be enlarged and deepened at a point where one is already partially formed. The rapid above should likewise be made easier in slope and deepened; and these things being done, fish would, I think, get up easily enough to the streams and pools above. Of course, in making these alterations on the right bank, the stream would require to be diverted into the channel on the left bank. There is at least a mile of river above the falls, then a considerable loch, then another mile of river. Altogether there are nearly a dozen lochs, large and small, belonging to the basin of the Badachro, all but two being above the falls.

There is no District Board for the Ewe, Badachro, and Kerry, and I have been unable to obtain any authentic return of the number of fish killed in these rivers and the districts belonging of them. But one gentleman states in answer to the query about the 'Take of fish,'—from 7000 to 8000 fish, over one-third of which are salmon, are killed by net, and about 200 by rods.

The Torridon, Balgay, and Shieldag.

The two first named rivers both run into upper Loch Torridon, the former into the head of it, and the latter into its south shore. The Torridon is a river of very clear water; but a good deal of its channel

is streamy and shallow, and might be greatly improved by the formation of artificial pools. The Balgay has a rapid course of about 2 miles interrupted by a considerable fall. It flows out of Loch Damph, a remote loch situated amongst wild mountains in the parish of Loch-carron. It is an extensive sheet of water, 6 miles long and upwards of a mile wide.

The Shieldag runs through the glen of the same name, and flows into the head of Loch Shieldag, a branch of Loch Torridon. The present estuary for these three rivers is 'a straight line drawn across the narrows between Loch Shieldag and outer Loch Torridon, where 'Diobaig Point and Ru Ardtishlic most nearly approach each other.' A better estuary would, in my opinion, be from Ru Ruag on the north, to Ru-na-Uag on the south.

The fishing in all these rivers has greatly fallen off. There are no bag-nets on the Applecross or south side of the loch. They are all set on the north side, up which the salmon run. These bag-nets are in a peculiarly remote and inaccessible position, the nearest bag-net being upwards of 8 miles from Torridon House, over a very steep and rugged mountain side. The temptations and facilities for not observing the weekly close time are, therefore, very great. The nets are leased from Sir K. Mackenzie of Gairloch.

One of the principal proprietors on Loch Torridon writes as follows concerning the 'Take of fish':—

The take of fish has diminished during the last ten years in the rivers. It could not, however, get very much smaller, as it has been quite ruined by the nets in the mouth of Loch Torridon. They were allowed there by the Commissioners without consulting the only two proprietors of rivers in the district, and have the effect of giving all the fish to a proprietor who has no river.

Fish caught by Rods in Balgy River.		1882.	1883.	1884.	} average, 11 fish per annum.
"	Spring,	0	2	3	
"	Autumn,	2	3	0	
"	Torridon River,	4	13	6	

It should be mentioned that 1883 was an exceptionally good year.

With reference to the observance of the weekly close time, the same gentleman writes—

I have no means of proving it, but my impression is, and that of all here, that the weekly close time for nets in outer Loch Torridon is not observed. The only two times that we have been able to inspect, we found the nets in outer Loch Torridon fishing without any close time at all. Inspection from here means eight hours' excessively hard hill walking on Sunday. I think it should at least be provided, that if the nets are left fishing on Sunday by any chance, an additional close time of thirty-six hours should be observed during the following week. This would, I think, be a slight improvement. Stake and bag-nets, as worked on this coast, are fast ruining the salmon fisheries altogether—not even leaving a breeding stock. The least that should be done is limiting them strictly to the coast line outside of the points enclosing any estuary or bay which is fed by a salmon river.

Mr Stuart of Kishorn, in his answers to the printed queries, writes as follows:—

Prior to the passing of the existing Fisheries Act, large numbers of salmon and grilse were taken with the rod in the rivers in this district. I have repeatedly caught 4 salmon and 3 salmon in one day with the rod in the River Balgy, and in Loch Doull, in Glen Shieldag. One year, in the month of April, one of Sir John Stuart's gamekeepers caught 20 salmon with the rod; and in the same year caught with net and coble, between high and low water mark, at the mouth of the Balgy, about 400 salmon and grilse. I have seen 52 salmon taken in three hauls of the net at the mouth of the Balgy. *Scarcely a fish now can be taken in the Balgy or Loch Doull.*

There are falls on the Balgy river, about a mile above Loch Torridon which seriously impede, though they do not entirely obstruct, the passage of salmon into the stream above the falls, into Loch Damph, and the feeders of Loch Damph. In these streams there is a large extent of excellent spawning ground. It would be easy to improve the falls by diverting the branch on the right bank into the central branch for a time, making a good resting pool in the middle of the right branch, and blasting away the top of the rock. There used, a good many years ago, to be a cage or pot on this right branch of the falls, formed of stones so placed that salmon attempting to ascend and failing, fell back into this pot and were captured. It was no uncommon thing, at that time, to take 5 or 6 salmon in a day in this pot. There are three or four natural pools between the falls in the Balgy and the sea, and three or four more might easily be formed artificially. But as one of the river proprietors on Loch Torridon writes in his answers to the printed queries—

There is a fall on the Balgy which could be blasted. There are splendid spawning grounds above at the south end of Loch Damph. But it is not for the interest of the upper proprietors to spend one penny in salmon culture, while the lower proprietor is authorised by law to take all the fish.

When at Loch Torridon, I satisfied myself, by an examination of witnesses on the spot, that there has been a very great falling off in the number of salmon in the rivers flowing into it, and I asked Mr Darroch of Torridon, who has had twenty years' experience of salmon fishings, both in the island of Lewis and in Loch Torridon, to draw up a memorandum with regard to this falling off in the river fishings, and the causes that have led to it. This he has been kind enough to do, and I now print his memorandum :—

On the Decay of the Salmon Fisheries in Rivers of North West of Scotland, particularly in Loch Torridon.

Decay of River Fishings. In my experience of the north-west coast of Scotland, extending now over thirty years, there has been a very marked deterioration of the salmon fishings in the rivers.

Cause, Fixed Nets. I attribute this entirely to the improved methods of fixed net-fishing on the coast, which fishing has been stimulated and developed to its present extent by the use of ice, and the facility of transport of fish ; and I am of opinion that the effect is now felt on the whole stock of salmon, the golden goose approaching its decease.

As much fallacy, however, and many sources of error lie in general statement, I will proceed to reason only from cases which I have been able personally to investigate, but I feel confident that a similar history attaches to most of the rivers on the north-west coast.

Salmon Fishing in west of Lewis at Uig. Ruined in 1865. Used to be good in old times. First, as to the salmon fishings on the west of Lewis. I was tenant of the Uig shootings from 1865 to 1873 ; the rivers and lochs there I found to be almost entirely ruined for salmon fishing, though the sea-trout fishing was still excellent. I found on inquiry that there used to be plenty of fish both for anglers and poachers ; and I have the evidence of Colin Maclean, now in my service at Torridon, aged 54, who was a crofter at Croulasta, Uig, Lewis, all his life, and worked with me as a gilly at Uig, that in the old time every burn was full of fish, but that bag-nets were put on at the Gallon Head, and Croulasta, both to the north of the Uig fishings, about forty years ago.

Bag-nets put on forty years ago. That in the first year 1800 fish were got at Gallon Head, and 1200 at Croulasta, and that the take of the nets gradually diminished, while the fish disappeared from the rivers.

Fish gradually became scarcer. That in the first year 1800 fish were got at Gallon Head, and 1200 at Croulasta, and that the take of the nets gradually diminished, while the fish disappeared from the rivers.

Sir James Matheson, being, fortunately for that district, both upper and lower proprietor, took off all the nets about ten years ago; and Maclean's brother, who is still a crofter at Croulasta, informs him that now the fish in the rivers are getting to be as numerous as formerly, and that salmon can now be caught with the rod where none could be got in my day.

William Macdonald, my keeper, aged 42, is the son of a crofter at Carashader, Uig, and was gilly with me at Uig. He saw the rivers in their desolate condition, and heard his father and others tell how good they used to be. He went home to Carashader on a visit six years ago, four years after the bag-nets were taken off, and found that there were plenty of fish again, all the small streams even being full of them when at all in flood.

It is quite evident then that, in this case, the bag-nets were the cause of the mischief.

I now come to a case in which I am more especially interested, and in which also I have been able to trace the deterioration of the fishing,—the case of Loch Torridon, with its two rivers, the Balgy and Torridon flowing into it, besides the smaller waters of Loch Doull.

The rivers Balgy and Torridon, with Loch-an-Iasgaiche, have been noted salmon waters from time immemorial, so much so that in deed after deed from the year 1624 they have been specially conveyed by name; the half of the salmon fishing of the short river Balgy even being thought in 1624 worthy of being split into two further equal parts between the representatives of the two heirs portioners of Donald of the Isles; and it is the fishing of these waters, so jealously guarded for hundreds of years, which has been wrested from the Crown grantees by the fixed nets authorised by the Act of 1862.

The fishings of the Balgy were valuable enough to induce the late Sir John Stuart to go to law with Col. M'Barnet, late of Torridon, for their exclusive possession, and that too, not only through all the Scotch Courts, but even up to the House of Lords.

There is ample evidence of the fishing having been most productive during the early part of this century, and fairly so up to about 1863.

John Mackenzie, Camustrole, Torridon, who gave evidence in Stuart v. M'Barnet, aged now 77, is prepared to prove that his father had the salmon fishing on the Balgy and Torridon up to about 1826, and that his operations being conducted in upper Loch Torridon, at the mouth of the River Torridon, the upper part of that river was sub-let to no less than three parties, who all made it pay, besides poaching for any one who liked.

Then, at the time when the Torridon people were scarce of food, the fishing provided food for every one. Every Saturday in July, for instance, every family used to get a fish from his father. Speaking in the presence of M'Beth and George Mackenzie, Camustrole said—'You, Mr Darroch, though you respect us three, could not believe how many fish we used to see!'

He says that he has not seen above half a dozen leap this year, and that the fish have all gone.

Hector Mackenzie, Taagen, on the Gairloch estate, gave evidence in Stuart v. M'Barnet, that he saw the young Laird of Torridon, in 1822 and 1823, with a rod going back from Balgy often. He would generally have a fine basket of fish, consisting of salmon, grilse, and trout.

Angus Macdonald, Baddanvungie, aged 59, who also gave evidence in Stuart v. M'Barnet, says that he used to get 5 or 6 salmon a day poaching in the Balgy, by their falling back into a hole below the fall, where he believes he could get none now. He has known the river all his life, living beside it. He and George Mackenzie, elder, were catching fish forty years ago, and George remarked to him, that there were more fish in the pool than there was water to boil them.

They used to put the gaff-hook in without looking, and get out fish. They would get 20 in a day. That was before the time of the bag-nets.

George Mackenzie, elder, 83 years old, who gave evidence in Stuart v. M'Barnet, and used to live near Balgy. He remembers lots of fish going up the Balgy Fall on a July day—ten at a time frequently every few minutes. He would get 8 or 9 a night poaching in the old time. Remembers a new net broken by the weight of the fish in the mouth of

Bag-nets taken off about ten years ago. Plenty of Salmon now.

Loch Torridon. Fisheries of Balgy and Torridon granted nominatim by Crown.

And wrested from owners by Act of 1862. Stuart v. M'Barnet.

Fishing used to be productive.

Evidence. John Mackenzie, Camustrole. Fish plentiful in 1826.

Hector Mackenzie, Taagen.

Angus Macdonald, Baddanvungie.

George Mackenzie, elder, Fasag. Salmon in Balgy used to be very plentiful.

**Plenty of fish
outside Torri-
don River
formerly.
Hardly any
now.**

**William
Cameron, Bad-
danvungie.**

Were plenty of fish in Balgy, and at mouth none now.

Donald
M'Beth, Fasag.
Plenty of fish
in Balgy forty
years ago.

Used to be
plenty of fish
at mouth of
Torridon,—
none now.

John Stuart, Esq. of Kishorn, caught in 1861 as many fish in one day as the Balgy produced in the year 1884.

Loch Doull,
1863.

**Alex.
Chisholm,
about 500 sal-
mon retted in
a sea-on about
1863 at mouth
of Balgy.**

Alpine Fraser.
No fish now at
mouth of
Balgy.

Duncan
Darroch of
Torridon.
Fish nearly
gone.

Used to be
plenty of fish.
None now.
Rod-fishing
now.

10 Salmon only
taken by rod
in 1884.

Donald Matheson, the keeper at Shildaig, tells me they have never got a salmon or grilse in Loch Doule since he came to the place eleven years ago.

It must also be taken into account that up to 1873 and a year or two after that, not only were salmon netted in Loch-an-Iasgaiche, the feeder of the Torridon River, and at the mouth of the Torridon, but the mouth of the Balgy was regularly netted by Sir John Stuart, and in spite of these nettings, fish were still caught by the rod. Both these customs of fishings have been discontinued years ago, in the hopes of improving the rod-fishing, but it has dwindled away, as has been shown to a beggarly total of 10 fish, caught in the whole year of 1884 by the two upper proprietors.

I think I have shown that the salmon fishing of the rivers in Loch Torridon is practically ruined, and it appears to me that the cause of this ruin is not doubtful. Poaching is quite extinct, at least in the upper proprietor's waters; in fact, it would not now, as the people tell me, be worth any one's while to poach.

Loch Torridon is about $14\frac{1}{2}$ miles long, average breadth about $2\frac{1}{2}$ miles, and $4\frac{1}{2}$ miles wide at the mouth between Red Point on the north, and Ru Uamh on the south, where it joins the Minch.

In the year 1838 bag-nets were first set in outer Loch Torridon; Donald M'Beth above mentioned was employed in setting them; there were only tow nets set then, and from this time rose by degrees the deadly system of nets which has ruined the rivers of Loch Torridon.

The Commissioners under the Salmon Act of 1862 visited this district when the river proprietors were absent, and fixed the estuary line at a point 7 miles within Loch Torridon, where it contracts to $\frac{3}{4}$ mile in width.

The practical effect of this decision, given behind the backs of the river proprietors, and from which under the Act there is no appeal, is to deliver over the gate leading to their fisheries to intercepting fixed engines. Sir John Stuart, when he found what had been done, at once wrote to Lord Moncreiff, but the injury was irreparable.

The salmon all come in by the north coast, the proofs of which are as follows:—

The case of the Uig fishings above mentioned tend to prove this to hold elsewhere; and as to Loch Torridon, John Mackenzie, Camastrole, above quoted, tells me that not only is it the general belief that all the fish come by the Red Point, but that when his father had the fishing, when he saw any Diabeg man (Diabeg being a place on the north-west coast of Loch Torridon, on the Gairloch estate, about 9 miles from Torridon River), he would ask him:—‘Are there any fish on your coast?’ If ‘yes,’ then as sure the fish were to come in a shoal as if he saw them with his eyes.

Hector Oag of Diabeg, used to send word to his father—‘Be of good hope, there are fish on the coast.’

The fish did not come in by the south coast of Loch Torridon, for Donald M'Beth, above quoted, says that Alex. Macrae, tenant of Torridon Mains fell out with Mr M'Barnet's trustees, and in 1842 set nets on the south side of outer Loch Torridon, between Inverbane and Ru Uamh, to spite the trustees, opposite to the nets which now fish, and then fished on the north side; and as he got no fish at all, M'Beth thinks all the fish come in by the north shore.

And John M'Kenzie, Camustrole, says that bag-nets were tried on the south coast of inner Loch Torridon, but never answered.

It is pretty clear then that all our Loch Torridon fish come in from the north round the Red Point, and it is inside the Red Point, between that and Craig, that the Commissioners of 1862 legalised the intercepting nets for ever, at a place situated in so rough a country, with no road, that it is four hours hard work for a man to get from here to the nearest net to inspect, and in fact it takes him his whole day.

The extinction of the fish would have been more gradual had the net-fishers complied with the law, but shortly after I came here, in 1874, hearing that the Sunday slap was never given, I sent to see on June 28th.

The Saturday was very fine and calm, so calm that my children were fishing in a punt till 8-20 P.M.; my men found all the nets fishing merrily, and the next Sunday, July 4, in fine weather, eight nets were again found fishing.

Donald Matheson.

No fish caught in Loch Doule in eleven years. Upper Proprietors have given up all netting.

River fishing in Loch Torridon District practically ruined.

Not done by poaching. Topography of Loch Torridon.

First Bag-nets. Two in 1838.

Salmon Commissioners of 1862.

Fixed Estuary line inside Loch.

Salmon all come in by north coast. Evidence of this.

John Mackenzie, Camastrole, his father.

Fish passing Diabeg, come to Torridon River.

Fish do not come in by south shore.

Nets were tried on south side of outer Loch Torridon and failed to catch fish.

Same on south side of inner Loch Torridon.

Position of the bag-nets.

Non-observance of Weekly Close Time.

Found Nets fishing on two Sundays running in calm weather.

Mode of payment of fishermen gave every inducement to break the law.

Inspection given up by me as useless ; but hope now, as inquiry is to be made. Upper Proprietors are most anxious to improve fisheries ; but they have no inducement, so long as their fish are given by law to another.

Effect of the Commissioners' action, as doing justice between Upper and Lower Proprietors in Loch Torridon. Conclusions. There should be power to regulate Estuaries anew. No fixed Nets should be allowed inside natural Estuaries. Sunday slap if omitted should be made up for again. Nets should give returns of number of fish caught. There should a jubilee for the fish, as far as fixed nets are concerned.

I ascertained then that the fisherman were paid by results, according to the fish they caught, and that if they considered the weather too rough to take in the leaders on Saturday, they thought they acted more piously in fishing on and taking our fish on Sunday for their own gain, than in lifting the leaders on that day. So that they had every inducement to take it easy on Saturday night, knowing that if they could only say it was too rough, they got extra profit for themselves.

This being the state of the case, I had given up all hope of protecting my property, and dropped inspecting as a useless and troublesome farce. But now, as inquiry is being made, I hope that the case of the north-west rivers may be re-considered.

Mr Murray of Lochcarron and I are most anxious to improve the fishery. We have talked of making a fish ladder or blasting, to let the fish freely up into the large spawning beds of Loch Damph and its feeders. I have been advised to make pools in the Torridon, and would be glad to try breeding and Mr Murray wishes to improve Loch Doull : but so long as the law gives the whole of our fish to the lower proprietor, it is not worth our while to spend one penny in developing the resources of our waters.

The Commissioners of 1862 having been employed to regulate a novel and destructive mode of fishing, that of the bag and stake nets, so as to do justice between upper and lower proprietors, have so ordered matters here that they have ruined the valuable river fisheries, so much so that the upper proprietors, who hold the river fisheries by Royal charter, get 10 fish in a year, while the lower proprietor, who has no river at all in Loch Torridon, and who neither breeds nor preserves salmon there, has been taking out of our stock the produce of eight or nine nets, a produce which, I have been told, must amount to many hundred pounds worth of salmon annually, before it can pay the lessee. I think that the least that should be done is :—

The Secretary of State should have power to inquire into, and alter if necessary the boundaries of estuaries.

In no case should fixed nets be allowed inside a natural estuary ; here, for instance, no fixed engine should be allowed inside the Red Point.

In case of the Sunday slap being omitted, by stress of weather or otherwise, thirty-six hours' slap should be given in the following week.

The lessees of nets should be obliged to give accurate returns of the fish they catch, so that the Secretary of State could see whether the take of fish was fairly divided between the upper and lower proprietors ; as things are at present, there are no means whatever of ascertaining the amount of fish intercepted by the nets.

I also think that, as the fixed net proprietors have had practically the whole of the fish for so many years, they should now be compelled to abstain from fishing altogether for a reasonable time, say one or two years ; in this way, the breeding stock would have some respite, the poor upper proprietors would have an instalment of their own fish ; and finally, it would be proved by the results of the rod-fishing, provided the season were an average fishing one, whether it is the nets that intercept all the fish or not.

If something be not done speedily, the salmon on the north-west coast of Scotland will soon become practically extinct, which is the more to be regretted, as the evident intention of the Legislature in 1862 was to protect the rivers, and while reserving a fair share to the lower proprietors, to protect and breed salmon ; instead of which, the tenor of the Act and the dealings of the Commissioners have left the upper proprietors bound and helpless in the hands of the lower proprietors and their lessees.

DUNCAN DARROCH.

TORRIDON, December 23, 1884.

Mr Murray of Loch Carron, a proprietor in the Torridon district, expresses similar views to those contained in the above memorandum by Mr Darroch. In his answers to the printed queries, he writes :—

The fishing in the fresh waters has greatly diminished, owing to the present position of the nets. In my three days a week of the Balgy, no salmon this year. This was a well-known river in previous years, and a

very few fish still find their way up. In Loch Dongall and river Kinloch Shieldaig, no salmon this year, or for a few years past. Fish were formerly regularly caught in this loch. A few still come up to spawn, and this loch might be improved, were it worth while to do so.

Then, as to alteration of estuaries by the Secretary of State, under certain conditions, he writes as follows :—

As regards Lochs Torridon and Shieldaig, for example, it is essential that this power be given ; and, generally, so far as I have opportunities of judging, such an amendment of the Acts is called for. It is not for an upper proprietor to make any selfish objection to the carrying on of the coast fisheries ; but those fisheries should, on the other hand, be so regulated, especially as to position, as not to destroy the stock of fish resorting to the rivers and fresh water lochs. I consider it essential, if any salmon are to be left in our little west coast rivers, that all estuaries and sea-lochs into which these rivers flow, be kept clear of stake and bag-nets, and that these be kept to the main coast line, outside the points.

The following extract from a letter from Mr Alexander P. Hogarth of Aberdeen, one of the most experienced lessees of fixed nets in Scotland, who has a number of stations on the west coast, defends and justifies the use of the bag-nets of which Mr Darroch so bitterly complains :—

I have no hesitation in saying, that without the use of both bag and trawl nets (net and coble), on the west coast of Scotland, that coast cannot be properly worked ; and with my experience of that part of the country generally, I believe that immense numbers of fish come to the coast during the months of June and July, and that, even under the most favourable circumstances, a very small proportion of them go up the rivers, the remainder fall off to sea again and are lost for the simple want of taking them when and how they can be got. I have seen as many salmon hanging about the mouth of the Ewe and the Gruinard (when netting is not allowed) as would nearly make a season's fishing, in one day, if I was allowed to take them out. I am satisfied that these fish dodge and hang about there, smelling the fresh water with little or no intention of going up, because probably there is not much water in the river, and when there is plenty of water, very few of the fish *actually* swim ; they fall off to sea along with the fresh water (when a spate does happen to come), and seem quite satisfied that they have had a taste of it ; and about the end of July they entirely disappear, and are not seen after that either in the rivers or about them, or at all events a very trifling proportion indeed of the thousands that come to the coast. These are the habits of the salmon round thereabout.

I take this opportunity of directing attention to a complaint made by Mr Hogarth of the present state of the law affecting even those lessees of bag-nets who give specific written directions to their men strictly to observe the weekly close time, whenever it is possible to do so. I shall let Mr Hogarth speak for himself in the following extract from a letter from him to Messrs Balfour, W.S., Edinburgh, on the subject of 'Sea Coast Salmon Fishings : '—

If there is one point more than another in which lessees of sea coast salmon fishings are deeply interested, it is the question raised by the 24th section of 31 and 32 Vict. c. 123, that is, the Act of 1868. The provisions contained in this section and sub-sections are of a most unfair and oppressive character, inasmuch as under these the occupier of a fishing who at the time an infringement of them takes place is, it may be, 100 miles distant from the fishing station, is tried criminally and punished, while the actual wrong-doer, the overseer in charge of the station, escapes without any punishment whatever.

In illustration of this, take the case of one who is both owner and occupier, as for instance, the Duke of Richmond and Gordon. He may be absent attending to his duties in the House of Lords when an offence is committed at any of his stations, and yet, by the negligence, or, for that matter,

perhaps for a piece of spite, the overseer in charge may not observe the Saturday slap. His Grace himself is held criminally liable, and must appear personally as such before the sheriff.

Take again, my own case as occupier of something like 40 different stations spread over a great extent of the north-eastern and north-western coast of Scotland, and yet for any breach of the requirements of the statute I am held responsible, notwithstanding that I have taken every care and precaution possible to prevent my servants committing such breach. And this is no hypothetical case, but simply what has been my own unfortunate experience on more than one occasion, and may be so again to-morrow for aught I can do to protect myself, and yet I am responsible for the due observance of this slap at each of these stations the same as if I were on the spot.

Now comes the question of penalty. The clause says 'he shall forfeit the net or nets, &c.' Could anything be more vague than that? What part of the net shall be forfeited? Is it the leader or the bag? The former being the only part of the net left illegally in the water. Or does the clause mean that the whole bag-net, anchors, chains, warps, buoys, &c., are to be forfeited?

Then take the 28th section. What does that apply to? Has that any reference to the question of observing the weekly slap at a fishing station? If so, the occupier is in a still more unsatisfactory position; for should his servant not observe the slap, either from negligence or spite, *all the fishing material* on the station is liable to be forfeited.

Then again, take the 32nd section of the above mentioned Act. That is vague enough in all conscience, but it is quite evident that this section must have been intended to apply only to the case of an ordinary poacher, and not to the occupier of a fishing, and so also in my humble opinion does the 28th section. But it does not say so, and I have seen the provisions of both these sections applied in a prosecution for the non-observance of the Saturday slap, against the unfortunate lessee, who at the time in question was hundreds of miles away from his fishing station, and when it was proved to the satisfaction of any man practically acquainted with such matters (although the sheriff in his wisdom did not think so) that the slap could not be observed on account of bad weather.

Suggestion with regard to Bag-nets and the Weekly Close Time.

I may mention, in connection with this subject, that in a Bill presented by the Marquis of Huntly, and ordered to be printed by the House of Lords in July last, there was a clause (the 32nd), providing that proprietors or lessees of fixed nets shall not be responsible for a breach of the annual or weekly close time, unless it can be shown that they have ordered, connived at, or approved of the same. But if it be necessary to provide against penal consequences affecting the proprietor or lessee of bag-nets who has given orders to his men to observe the weekly close time, but who, nevertheless, have disobeyed such orders; it humbly seems to me that it is at least equally necessary to take some steps to enforce the observance of the weekly close time by the owners of these nets, by providing that, if it cannot be kept at the time provided by statute, thirty-six hours—or whatever other weekly period may hereafter be fixed—shall be kept at a later period of the week, and by appointing officers, where there is no District Board, to see these regulations carried into effect. Or, if this be objected to, then to give a trial to the alternative recommended by the Select Committee of the House of Lords in 1860, namely, to abolish the weekly close time altogether, so far as regards bag-nets, and to take, instead, a month off their fishing season.

The Carron.

The Carron rises in Loch Scaven, flows thence 6 miles into Loch Doule, and after passing through it, has a farther course of 5 miles, and joins the sea at Loch Carron. It belongs to Lord Wimborne and Sir Alex-

ander Matheson, Bart. Loch Doule and Loch Scaven are frequented by salmon and sea-trout in the season. The Factor to Lord Wimborne, one of the principal proprietors on the river, writes as follows:—

The rod fishing of the River Carron has improved during the last year or two, which I chiefly attribute to the fact that Lord Wimborne, who at present is chiefly interested in that river, has, at very considerable expense, kept men to watch the mouth of the river, and protect it from poachers and such like. In previous years many more fish used to frequent the River Carron. The following is a list of salmon killed on Carron since 1875, viz:—

In 1875,	34 salmon.	In 1881,	9 salmon.
„ 1876,	18 „	„ 1882,	24 „
„ 1877,	14 „	„ 1883,	122 „
„ 1878,	9 „	„ 1884,	40 „
„ 1879,	8 „		up to 10th May.
„ 1880,	5 „		

Previously to 1875, I have no statistics; but the keeper informs me that there has not been of late years 1 fish for 20 that used to frequent the river.

Clean fish have been got in the Carron on 11th February. The main take by rod is in April and May for spring fish, and last half of July and August for autumn fish. The grilse run in July. There is no District Board on the Carron. An attempt was made about two years ago by Lord Wimborne to have one constituted, but it failed.

The Luining and Elchaig, Crowe and Shiel.

The Luining and Elchaig belong entirely to Sir Alexander Matheson, Bart. They both fall into the head of Loch Luining, uniting close to the sea. Loch Luining is a winding salt-water loch, narrow, and with a rapid tide. It is 6 miles long, and joins Loch Duich, a larger arm of the sea, about 5 miles from Balmacara. The Luining is the more northerly of the two rivers. About two miles above its mouth, there are considerable and very picturesque falls, upwards of 20 feet in height; but at present, in spite of some operations which have been carried out to enable salmon to ascend, they are practically an entire barrier; only two or three fish having ever been known to surmount them. The best chance of enabling them to pass up would be on the left bank, where the fall is divided and broken, though a great weight of water comes over it in floods. Something has already been attempted, but a good deal more requires to be done before salmon will be able to ascend freely to the 9 miles of river above, which contain twice as many good angling pools as there are in the river below, and also a considerable extent of excellent spawning ground. For 6 miles out of these 9 the river above the falls remains as large as it is below them, but for the remaining 3 miles it is a good deal smaller. The salmon of the Luining are handsomer than those of the Elchaig, being thick, short, and small in the head; while those of the Elchaig are longer and thinner. They are, however, said to rise more freely in the Elchaig, and it is the better river for sea-trout.

The pool above the falls of the Luining is from 15 to 20 feet deep, and the rush of water at present in the topmost part of the falls is such that no fish could face it. Blast out topmost branch of fall, deepen channel in centre, and make subsidiary dam across river some distance below, where a big rock stands out of the channel when the water is low, and I think salmon might then be able to surmount the fall. But it is a bad fall to open up—much worse than the Falls of Tummel—and the banks are perpendicular both above and below. I have no doubt, however, that a 'Macdonald Fishway' could be successfully

applied to this obstruction. But this could be ascertained by applying to Mr John Young, C.E., Perth, who is Colonel Macdonald's representative and agent in this country.

There are likewise falls on the Elchaig about 3 miles up. But neither in height nor in volume and rush of water, are they to compare with those on the Luing. On the right bank of the stream there is a sort of natural salmon-ladder which has been improved by artificial means, so that salmon have no difficulty in ascending when the river is in a suitable state. There are about 7 miles of good fishing water on the Elchaig. There are no bag or stake nets within 15 miles of the mouths of the Luing, Elchaig, Crowe, and Shiel. The result is that the rod-fishing is good; 50 and 35 fish having been killed, in recent years, by one rod in a season in the Luing and Elchaig, and 50 in the Crowe.

The Crowe, which falls into the head of Loch Duich about 3 miles from Shiel Hotel, is frequented by salmon, and occasionally affords excellent sea-trout fishing. Its waters are remarkable for their clearness.

The last salmon river on the west coast of Ross-shire is the Shiel, which runs through Glen Shiel amidst magnificent mountain scenery, and falls into the head of Loch Duich close to Shiel Hotel. It contains salmon, grilse, and sea-trout in the season, which are also found in Loch Shiel, a small weedy loch about a mile in circumference, a short distance from the mouth of the river. The Shiel is a late river, the best season for salmon and sea-trout being from the end of May to September.

THE SALMON RIVERS ON THE WEST COAST OF INVERNESS-SHIRE.

I may mention, at the outset of my account of the Salmon Rivers on the west mainland coast of this extensive county, that there is only one District Board—that of the Lochy and Spean. The other rivers are much too small to maintain District Boards; though, if they were combined into groups, they might possibly be able to do so. I may take this opportunity of stating that I know, from personal communication with one of the original Commissioners under 'The Salmon Fisheries (Scotland) Act, 1862,' that the Commissioners would, in many cases, have been inclined to group together several of these smaller rivers into one Fishery District, if they had not considered themselves bound, by the terms of the 6th section of the said Act, to assign a separate district to each river.

The Glenelg and Glenbeg, the Arnisdale and Inverie.

I drove from the Shiel to the Glenelg river by a very steep road which crosses the Mam Rattachan at a height of 1200 feet, and then slopes downwards to the green strath of Glenmore, through which the Glenelg flows for about 8 miles before it falls into the Sound of Sleat, which runs like a broad river between Skye and the Mainland. The upper part of the Glenelg river is shallow and streamy, and might be

greatly improved by judicious pooling. At Scalasdale, about 3 miles from the inn at the mouth of the glen, there are some good pools for salmon, especially one beginning at a wooden bridge across the river. About a mile and a half southward from the mouth of the Glenelg, another river, nearly the same size, called the Glenbeg, falls into the sea. Both salmon and sea-trout ascend it. But no estuary has been fixed for it. In my opinion, there should be one estuary including both rivers, and it should be a straight line drawn from Kyleree rock on the north to Craig-an-dhuan rock on the south.

Both the Glenelg and the Glenbeg are very late rivers, though their close time has been fixed from 27th August to 10th February, both days inclusive. It ought to be from 10th September to 24th February, both days inclusive. August is the best fishing month on the Glenelg, and nothing is done on the river until the month of June. Between 5 and 6 miles up the glen there is a high bank or scaur, on the left bank of the river; and, on the right side, the banks rise a few feet, while the ground is rushy, and not of much value for agricultural purposes. Here a dam might be thrown across the river in a diagonal direction for about 100 yards, which would form a small loch a few acres in extent, the very thing wanted in the Glenelg. It would furnish a resting place for fish, and in the centre, in the river channel, there would be a considerable depth of water. A mile of the river, upwards from the mouth, is in the hands of the hotel-keeper. Then comes the Manse water, belonging to the clergyman, and extending to about a mile, in which there are two very good pools. In the autumn of 1883, three rods killed 7 fish on this water in a day, the largest being 22 lbs.—the heaviest salmon killed on this river for many years. Between 20 and 30 fish were captured in this part of the Glenelg in 1883.

The Inverie and Arnisdale are two small and remote rivers. The former falls into Loch Nevis, and belongs to Mr Baird of Knoydart; and the latter falls into Loch Hourne, after a course of about 4 miles. It belongs to Mr Baillie of Glenelg. Both are late rivers, the best months being July and August.

The Morar and the Aylort.

The Morar is a broad clear stream, with but a short course, not exceeding a mile, connecting Loch Morar with the western sea. This loch is a splendid sheet of water about 14 miles in length, and varies in breadth from $\frac{1}{2}$ a mile to 2 miles. Arisaig, the nearest inn, is 6 miles distant. Both loch and river contain salmon, sea-trout, and yellow trout. The tide ascends as far as the bridge over which the road passes; and between the bridge and the Falls of Morar, a distance of a few hundred yards, there are some good pools. These falls do not constitute an absolute obstruction, as both salmon and sea-trout can ascend in favourable states of the river, but they are a decided impediment, which might, however, be easily and cheaply removed by blasting out some of the rock at the top of the sloping part of the falls on the left bank of the river; or a Macdonald Fishway might be put in.

A lake called Loch Beoraik, $2\frac{1}{2}$ miles long, drains into Loch Morar through the little River Meoble, which contains some good pools. There is a fall at the outlet of Loch Beoraik which at present obstructs the ascent of salmon. But it is by no means an insurmountable

obstruction; and if a fishway were put upon it, or if it were judiciously blasted, Loch Beoraik would probably be an excellent salmon and sea-trout loch during the latter part of the season.

The Aylort runs into the head of the salt water loch of the same name at Kinloch Aylort. It issues from Loch Eilt or Rannoch, a fresh water loch in three divisions, consisting of a small shallow upper loch; connected by a narrow canal, with a longer and deeper middle loch, then a second narrow, and thirdly the lowermost main loch, many times larger than the other two put together. From the seaward extremity of this, the river flows for a short distance, then expands into a small loch, in which is a wooded island thickly covered with Scotch fir trees, and issuing from its lower end, falls, after a course of about 2 miles, into the sea. Just above this little loch are the remains of an old cruive dyke. The angling for salmon, and especially for sea-trout, in Loch Eilt and the Aylort river used to be first-rate. Indeed, for sea-trout, both as regards number and size, it was at one time only second to Loch Stack, in Sutherlandshire. But of late years it has greatly fallen off; and when I inspected the loch and river in the end of last July, the sport had been very poor, though that was, of course, imputable in some degree to the unusual dryness of the season.

The Aylort and Loch Eilt are late, there being no good fishing until June. There is more than a mile of fine spawning ground in the stream that runs into the head of Loch Eilt. Then come falls above which no fish can ascend. I saw several seals in Loch Aylort and in Loch-na-Nuag, the larger sea-loch beyond, and I was informed that they are numerous in both. Doubtless they levy a heavy toll on the salmon and sea-trout passing to and from the river. The present estuary of the Aylort is 'a straight line drawn from the 'outermost point of Aird Nish on the north shore, through Goat 'Island, to the mainland on the south.' I venture to think that a better estuary would be 'a straight line drawn from Aird Nish to Ru 'Smirsiri.'

The Moidart.

The Moidart flows through Glen Moidart into the head of the salt water loch of the same name. It is a small stream, but is frequented by salmon and sea-trout, which ascend to Loch Lochana, a lakelet scarcely a mile in circumference. The Moidart salmon are not so handsome and well-shaped as those of the Morar, a few miles to the north, or as those of the Shiel which flows into the south side of Loch Moidart. The Shiel salmon are about the handsomest fish in Scotland—short, deep, and thick, with small heads; whereas the Moidart salmon are comparatively long lanky fish, with larger heads. This difference is somewhat remarkable, as both the Moidart and the Shiel fall into the same sea-loch, and the salmon of both rivers have, presumably, the same feeding grounds.

The Lochy and Spean.

These are by far the most important salmon rivers on the west coast of Scotland. They are entirely kept for angling, and the average annual take of salmon and grilse amounts to 1200, and of sea-trout to 1600. The first clean salmon are taken in March; the main run of fish is in June and July; the grilse come up in June. The

right to the salmon fishings in the district is almost entirely vested in Lord Abinger. The Lochy rises in Loch Lochy, and after a course of about 8 miles joins the sea at Loch Eil. The Spean issues from Loch Laggan, a lake 7 miles long, situated amidst magnificent mountain scenery, and after a course of 16 or 18 miles, unites with the Lochy at Mucomer. The pool formed by the junction of the two streams is probably about the best salmon pool in Scotland, and a single rod has captured 70 salmon in it in a month. The salmon in the Lochy and Spean run large, the average weight being about 15 lbs. The little River Roy, which joins the Spean at Roy Bridge, also contains very heavy fish in the latter part of the season; salmon from 30 lbs. to 40 lbs. weight having been occasionally taken out of it.

Productive, however, as the Lochy is, it seems to have produced a much larger number of fish about one hundred years ago, though its rental was then not much more than a tenth of what it now is. This is evident from the following extract, taken from the account of the parish of Kilmalie, in Sir John Sinclair's Statistical Account of Scotland, published in the end of last century :—

The principal fishing is upon the Lochy, the property of the Duke of Gordon and of Mr Cameron of Lochiel. The following table will show the number of fish caught upon it during the last seven years, their prices at Fort-William, and the markets to which they were exported :—

Year.	Salmon.	Grilse.	Price of each cask.	Market to which exported.
1785	3,678	976	£5 2 0	Aberdeen.
1786	2,036	3,899	4 13 6	Ostend, by Aberdeen.
1787	5,279	819	4 1 0	Bilboa.
1788	1,498	2,032	3 10 0	Ostend, by Aberdeen.
1789	1,260	835	3 0 0	Aberdeen.
1790	1,041	830	3 0 0	Ostend, by Greenock.
1791	576	1,200	3 2 6	Aberdeen.
	15,368	10,591	£26 9 0	

Each cask contains about 80 grilse, or 28 salmon and 8 grilse. The price of each cask, including salt, cooperage, &c., costs 13s.* The rent of the river and expenses attending the fishing are about £370 a year, the average of these seven years is 2195 salmon and 1573 grilse, equal to 92 barrels; which, at the medium price of £3, 16s. 8d., are worth only £352, 13s. 4d.; whereas the rent and expenses, as stated, are £370 per annum. It is, however, to be observed that it is only within these three last years that the river has been rented so high; and likewise, that the rent of a farm, worth at least £50 per annum, is included in the £370. Every year since 1787, there has been a great decrease in the number of fish caught, which must proceed from some inattention in preserving the salmon fry. The cruives of the river, it is thought, is the chief cause, as the fish are thereby prevented from going to the fresh-water lakes to spawn.

There are no cruives now on the Lochy; no netting in the river, which is preserved for angling, and is most thoroughly and efficiently watched; and no stake or bag-nets nearer than 16 miles from its mouth. It has, therefore, preserved its high character as a salmon river better than any other stream on the west coast. On the Lochy, just above

* Taking the grilse at 5 lbs. weight each, we find that the price per lb. at the lowest sum per cask, given in the above table, was a little under 2d. per lb.; and if we take the highest sum per cask, it was a little over 3d.

its junction with the Spean at Mucomer, a salmon-ladder has been constructed on a very nasty fall which enables salmon to surmount it without difficulty; Lord Abinger writes as follows about it:—‘There is only one salmon-ladder, at the Falls of Mucomer on the Lochy. It affords a free passage to the fish at all times.’

The following extracts from Lord Abinger’s answers to the printed queries are worthy of attentive consideration, not only from his holding the whole of the salmon fisheries in the extensive district of Lochaber, but also from his long experience in the management of the two most important salmon rivers on the west coast of Scotland. With regard to the vexed questions of bag-nets, his Lordship writes as follows:—

The increase of stake and bag-nets, and the increased power of the engines used, and increased knowledge of the habits of the salmon, requires a longer weekly close-time, to at least forty-eight hours for all fixed engines either in the sea or rivers. A varied close-time for nets and engines, other than rod or line, in rivers of any length, would be a great improvement. I have reason to think that the law as to weekly close-time is habitually disregarded. The estuary and the coast nets are so far distant that it is necessary to have the assistance of a government vessel and the coast guard to assist in enforcing the law; the expense renders it impossible for private persons or districts to see the law obeyed. The increase of fish in the river is met by increased length of bag-nets on the coast. The number of fish in the river has remained stationary for many years, though from there being no nets or fixed engines in the river, there should have been a large increase of fish. There are not nearly so many fish as there were forty years ago. Afterwards he writes:—It would be a great improvement in many rivers, where there are many conflicting interests, if the proprietors were to form a common society with proportionate interests, and fish the rivers as a common property. This would greatly increase the rental by cheapening the cost of bringing the fish to market, and the work could be done by one-fourth the number of hands and boats now employed.

At least 40 miles of rivers and lochs belonging to the basin of the Spean are barred against the ascent of salmon by the Falls of Mounessie. Of these falls, Mr Buckland and I write as follows in our Report of 1871, on the effects of recent legislation on the Salmon Fisheries in Scotland:—

Falls of Mounessie.—The Spean is already a highly productive river, but its spawning grounds, as yet, are not half utilised. At the Falls of Mounessie the river rushes with great velocity through a mountain gorge, is very much narrowed in its course, and the salmon are at present unable to surmount the fall, which is perpendicular, and 22 feet in height. If, however, it were made passable for them, and the fall at Inverlair, a little way above, were also improved, they would have access to at least forty miles of water, including four lochs—Loch Laggan, Loch Gulbin, Loch Ossian, Loch Treig, and their tributary spawning grounds.* It would not be impossible, though probably expensive, to open up the Falls of Mounessie; but here a legal difficulty arises. The lower proprietor in this case claims a right to follow the fish past the fall, and on to the lands of another proprietor, in consequence of his holding a Royal Charter for fishings extending, with certain exceptions, throughout the lordship of Lochaber. The other proprietor, however, to whom the falls and the river above for a considerable distance belong, will not allow the rock at Mounessie to be touched, unless under a stipulation that he gets a right to the salmon fishing in a certain portion of the river above the falls.

Though the Falls at Mounessie are 22 feet high, the pool immediately above is 25 feet deep, and only a wall or dyke of hard

* A map showing the extent of river and lochs that would be opened up by making the Falls of Mounessie passable for salmon, will be found in the Appendix to the Report of 1871, drawn up by Mr Buckland and myself.

rock, from 5 to 6 feet thick, separates it from the water below. Were the difficulties, therefore, arising from the collision of the rights and interests of the neighbouring proprietors removed, the falls might soon be made passable.

Last summer I again inspected the Falls of Mounessie and Inverlair, and examined, much more minutely than I was able to do in 1870, the rivers and lochs which would be opened up by making them passable for salmon. The falls at Mounessie are 22 feet in height, and quite perpendicular, and below them the banks are of hard bare rock, rising sheer up from the deep pool beneath; while above the falls they are also steep. Then, too, the river is very much narrowed at this point, so that when it is at all high, there is a great rush and weight of water tumbling over the falls. Altogether, the obstruction is a most formidable one. But, probably, it might be overcome by blasting out one half of the rocky barrier between the pool above and the pool below, and then forming subsidiary dams across the river bed above and below the falls. Or, possibly, a 'Macdonald Fishway' would enable salmon to surmount the falls. About a quarter of a mile above Mounessie, there is a smaller fall, with a considerable rush of water over it, and from 6 to 8 feet high, which would certainly somewhat retard the upward progress of salmon, even were they enabled to penetrate so far. But, on the left bank, there is a natural cut with a stream of water flowing through it, which might easily be enlarged so as to allow fish to ascend.

Four miles above the Falls of Mounessie, we encounter the Falls of Inverlair, which, in my opinion, would effectually stop the ascent of salmon, even were the Falls at Mounessie made accessible. Between these two falls there are 4 miles of river, with many splendid pools and streams, and some good spawning ground. Just below the Inverlair Falls, there is a long, foaming rapid, terminating in a deep black pool. Then above, at the head of the rapid, are the falls, not so perpendicular as those at Mounessie, but with a dash and swirl of descending water when the river is at all high, which could scarcely be surmounted by the strongest ascending fish.

On the left bank, however, there is a sort of channel in the rock through which part of the river now passes; and it would not be very difficult, when the river is low, to widen and deepen this channel, and carry the top of it further up the stream, and likewise to blast the lower part, so as to make access from the pool at the foot of the falls possible.

There is much more good spawning ground on the Spean above the Falls of Mounessie than below, especially in the neighbourhood of Moy, where the spawning ground is excellent; whereas, below the falls, much of the bed of the river is rocky and unsuitable for spawning purposes. Some of the tributaries of the Spean, too, above the falls, especially the Gulbin, a stream about the size of the Roy, have much good spawning ground.

It seems clear to me either that both the falls at Mounessie and Inverlair should be made passable for salmon, or neither; as it would certainly not be worth while to incur the expense of making the falls at Mounessie passable for salmon for the sake of the 4 miles of the Spean between Mounessie and Inverlair; whereas, if both falls were rendered accessible, 9 miles of the Spean; Loch Laggan, and its feeder the Pattock, up to the Falls of the Pattock; the Gulbin, and Lochs Gulbin and Ossian; and the Treig, below the falls on it, would be opened up to salmon—or about 25 miles of river and three lochs, one of them 7 miles long.

Legal difficulties attending the opening up of the Falls of Mounessie and Inverlair.

The Falls of Mounessie and Inverlair, and the property on both sides of the Spean in their neighbourhood, belong to Colonel Walker of Inverlair, and further up the Mackintosh comes in. But neither of them has a right to the salmon fishing, the whole salmon fishing in the district of Lochaber being claimed by Lord Abinger. If, therefore, they allowed him to open up the falls, or opened them up themselves, without any previous arrangement, they might simply be giving him a right to fish on their property; whilst they themselves would have no right to cast a fly on the water so opened up, though the falls, the bed of the river, and the property on both sides belong to them. This arises from the fact that, in Scotland, salmon fishings do not pass as part and pertinent of the adjoining land, but form a separate property (*separatum tenementum*), requiring a special title, mere riparian ownership giving no title, even to rod-fishing for salmon, without a charter of fishings. It would, indeed, be open to the proprietors above an absolutely impassable obstruction, like that of the Falls of Mounessie, beyond which no salmon has ever penetrated, to plead against the holder of a charter to all the salmon fisheries in the district, in the event of the falls being opened up, and a new salmon fishery created, that that new fishery belonged to the Crown—in whom all the salmon fishings in Scotland were originally vested—on the ground that the Crown could only grant the salmon fishings which existed at the date of the charter, namely, those below the impassable falls, and could not convey a thing not then in existence, namely, the salmon fishings above; and that, consequently, the new salmon fishings, created by the removal of the falls, would vest, not in the chartered proprietor below, but in the Crown, who might grant them to the riparian owners or to any other person. Difficulties of this kind, operating most unfavourably against the opening up of extensive and valuable fishings in rivers and lakes, are said to exist not only in the case of the Spean, but also in the case of the Tummel, and elsewhere in Scotland, and much care will be required in dealing with them in the event of future legislation.

As I was anxious to inspect the River Gulbin, the principal tributary of the Spean above the Falls of Mounessie and Inverlair, I drove from Fort William to Moy Inn, got ferried across the Spean, and walked along the whole course of the Gulbin, which runs through a wild and remote moor up to Loch Gulbin and Loch Ossian. The Gulbin has a course of 6 miles from Loch Gulbin to the Spean, and its course between Loch Ossian and Loch Gulbin is about 3 miles more. Loch Ossian is 3 miles long, and Loch Gulbin 1. The Gulbin, between Loch Gulbin and the Spean, is a perfect model of a small salmon river. It was fairly full when I saw it, but by no means in flood—just in good fishing order. There are a number of falls on it, with beautiful pools below; but very few of these falls would retard the progress of salmon. Altogether, there are sixteen pools, some of them long and deep, in the lower part of the river in the space of little more than a mile. Farther up comes a flat streamy piece of water, then a gorge, and a wooden bridge across the river, with a long, deep, dark pool below it. There is a fall here of at least 8 feet high, but it would not be difficult or expensive to deal with. Above the bridge, there is a long stretch of streamy shallow water, then a deep still pool, that would fish well with a strong breeze; and between it and Loch Gulbin are six other good pools. Loch Gulbin is about 3 miles in circumference. The 3 miles of stream uniting Loch Ossian and Loch Gulbin contain the finest spawning ground on the river. From the Gulbin I walked across to the Treig,

which runs into the Spean out of Loch Treig, one of the most remote and inaccessible lochs in Scotland, in which the great lake trout (*Salmo ferox*) are said to be both numerous and large. About half a mile above its junction with the Spean, there is a long rapid in the bed of the Treig, almost immediately succeeded by a perpendicular fall of 10 feet high, which would entirely prevent, or, at all events, seriously interfere with the ascent of salmon; and as there are several other falls at no great distance from each other in this part of the river, I am inclined to think that salmon could not penetrate to Loch Treig, even if the great Falls on the Spean were made passable.

The Leven.

This river flows through the singularly wild and picturesque scenery of the Kinlochmore Deer Forest, into the head of Loch Leven about 12 miles above the Loch Leven Hotel, which is situated on the banks of the loch almost opposite Ballachulish. The Leven is a beautiful stream, about as large as the Spean at Moy. There is not much more than a mile of it accessible to salmon. But in that mile there is a series of splendid pools—one, especially, beginning some 50 yards above the bridge across the river and continuing for more than 100 yards below. There are a number of falls in the course of the river—one of which, about a mile from its mouth, is from 18 to 20 feet in height, and forms a complete obstruction to the farther progress of salmon. The banks of the stream here are very densely wooded. A considerable body of water comes over this fall. But it might, nevertheless, be made passable if there were no other falls to deal with. But, unfortunately, a couple of miles farther up there are three other falls close to each other as impassable as the first fall. So that although there are several lochs beyond through which the Leven flows—the chief of which, Loch Eilt-an-Mor, is some miles in length—no probable increase in the value of the fishings would ever repay the outlay required in order to create them by opening up the falls. How precipitous the course of the river is may be judged from the fact, that it falls no less than 992 feet in little more than 6 miles, or upwards of 160 feet per mile.

THE SALMON RIVERS OF ARGYLLSHIRE.

There are 32 salmon rivers in Argyllshire, and only one District Board; so that, so far as this extensive county is concerned, the official machinery intended to be created by the Salmon Fishery Act of 1862 can scarcely be said to exist. And one consequence of this is, that, instead of the fishings paying assessments in proportion to their value for the protection of the rivers, the rivers are protected by gamekeepers and watchers paid by the river proprietors, who breed all the fish and catch a mere fraction of them; while the bag-nets near their mouths, which capture nine-tenths of the salmon bred in the rivers, do not pay a single farthing for their protection.

The fishings belonging to individual owners and fishery districts in this county are, in general, much too small to maintain and pay the

Failure of the system of District Boards on the West Coast: remedies suggested.

clerk and river watchers necessary to a District Board. But, as already stated, if a number of small separate, but adjoining Districts, were grouped together into one large District, the assessments levied on the fishings belonging to the combined District, including of course the the sea-nets, would be sufficient to pay a District Board clerk and a staff of watchers. Such a combined District, too, might be able to maintain a steam-launch to see that bag-nets were not set or used within estuary lines; that the weekly close time was duly observed by them; and that poaching for salmon and sea-trout by unqualified fishermen, or, as it is locally termed, 'scurring,' in the sea lochs and off the mouths of rivers was prevented or punished.* As an example of what such a combined District should be, I would suggest the Creran, the Awe, the Nell, Feochan, and Euchar, and the Add. These combined districts might be able to maintain a practically useful District Board, with an efficient staff of watchers, holding its meetings at Oban as a convenient and accessible centre.

Then farther north, in Ross-shire, Inverness-shire, and Argyllshire, the Kennart, Ullapool, Broom, Gruinard and Little Gruinard, and the Ewe might be combined into one District; the Kerry and Badachro, the Torridon and Balgy, the Applecross and Kishorn might form another; the Carron, Elchaig and Luing, Shiel, and Crowe might form a third; the rivers of the mainland side of the Sound of Sleat from the Glenelg to the Morar, both inclusive, might form a fourth; the Aylort, Moidart, and Shiel a fifth; and the Aline, with the rivers on the Morven and Ardgour side of the Linnhe Loch, as far up as the Scaddle and Cona, and the Leven, a sixth combined District. This would give, counting the existing District of the Lochy and Spean, only 8 fishery districts, instead of 29, on the western mainland from Loch Broom to Loch Crinan.

In order to show how very small the salmon rivers in the Western Highlands are in general, and how impossible it is for each small stream to which a separate Fishery District has been assigned, under the Act of 1862, to maintain the machinery of a District Board, I may mention that, between Cape Wrath and the Mull of Cantire, a distance of 250 miles, there is only one river with a drainage area of 500 square miles; and that the drainage area of the whole salmon rivers on the west coast of the counties of Sutherland, Ross and Cromarty, Inverness, and Argyll combined, is very little more than the drainage area of the single River Tay on the east coast—Tay, 2510 square miles; west coast rivers, 2605. It is the poverty of the fishings, not the apathy of the proprietors, that has prevented the proprietors on these small rivers from constituting District Boards. In the western counties between Sutherland and the Mull of Cantire, there are only three rivers whose watershed is above 100 miles, and separate Fishery Districts have been assigned to streams with watersheds of 7, 8, 13, 14, 16, and 17

* In our Report of 1871 on the effect of recent legislation on the salmon fisheries in Scotland, Mr Buckland and I write as follows upon the subject:—'It would probably very much conduce to the protection and development of the fisheries in the West Highlands, if several fishery districts would combine to purchase and maintain a steam launch, to watch poachers and enforce the observance of close time. The coasts and islands in that quarter are so deeply indented by sea lochs, that poachers at present have every facility for escape in their well-manned and fast-pulling boats. But they would have very little chance against a steam launch; and the certainty of detection and punishment would soon have the effect of preventing infringements of the Acts. With 3 or 4 such boats between Oban and Cape Wrath, the coast could be watched much more effectually than at present.'

square miles. How can the assessment on such paltry streams, and perhaps on two or three bag-nets within their statutory limits, support the expense of constituting and maintaining a District Board? The system of District Boards applied to such rivers has proved an utter failure; and it humbly appears to me, either that some other system must be devised and adopted, or that, if the present system is to be continued, a number of these small Rivers and Districts must be combined, as above suggested, into larger Districts; and such power of combination should be conferred upon the Secretary of State in any new Salmon Fishery Act. He has power to combine or divide Fishery Districts under the English Salmon Fishery Acts, and I venture to think that he should have the same power in Scotland.

The Shiel.

This is a very considerable river, which flows in a broad, short, full, stream into the side of Loch Moidart, and issues from the foot of Loch Shiel, a narrow lake 23 miles in length, which separates Argyllshire from Inverness-shire. Both loch and river contain salmon, grilse, and sea-trout, as well as yellow trout, which often attain a great size. Salmon of 33 lbs. weight have been taken in the loch with the net, and sea-trout as heavy as 7 lbs. But the sea-trout fishing is not so good as it was twenty years ago, and the yellow trout fishing has very much fallen off. Loch Shiel is a much later loch than Loch Tay; the fishing being not good for much until the month of June. The River Shiel is also a late river. A little above the bend in Loch Shiel, at a place called Polloch, a pretty little stream joins its waters. This stream flows out of Loch Doilate, a picturesque lake situated amidst grand mountain scenery. It is a mile and a half in length, and the sea-trout fishing in the end of the season is often first-rate, the trout being both numerous and large. It humbly appears to me that the estuary provided for the Shiel and Moidart, both of which run into Loch Moidart, is too small, and that, if it were enlarged, the salmon fishing both in the river and in the loch would be very much improved. The present estuary for the Moidart and Shiel is 'a straight line drawn from Farquhar Point on the south shore to the southwest point of Eilean Shona, and a straight line drawn from the north-west point of Eilean Shona to the nearest point of the mainland on the north.' It should be 'a straight line from Ru Smirsiri on the north to Ru Driminish on the south.' The propriety of this extended line was strongly pressed upon me in 1870 by the late Mr Hope Scott, who then possessed about 12 miles of the north side of Loch Shiel, and the whole of one side of the River Shiel; and also by the late Sir Thomas Miles Riddell, Bart. of Ardnamurchan, who was the proprietor of the whole of the south side of Loch Shiel. It would, however, be strongly objected to by Mr Dalgleish of Ardnamurchan, whose bag-nets, now worth a good many hundreds a year, would be reduced in number and value by the extension of the estuary.

The Aline, Kingairloch, Sanda, Gour, Cona, and Scaddle.

These are all small rivers in the districts of Morven and Ardgour,

with a united drainage area not exceeding 130 square miles. The Aline is the largest and best of them. It runs into the head of the salt water loch of the same name, which is situated on the east side of the Sound of Mull. It is formed of three streams, one issuing from Loch Ari-innis, and two others flowing through the parallel glens of Glen Dubh and Glen Geal. It is occasionally a most productive river, as many as 5 salmon and 30 sea-trout having been taken out of it in a single day by one rod. The sea-trout fishing in Loch Ari-innis is also first-rate. The Aline flows into the northern extremity of Loch Aline at Kinloch Aline; and another considerable stream flowing out of Loch Ternate, a fresh water loch abounding in trout, falls into its north-eastern extremity. But only a little way above its junction with Loch Aline there is a lofty and perpendicular fall, which is a complete barrier to the farther progress of salmon.

The Kingairloch River falls into a beautiful bay surrounded by lofty hills, green to the very summit. This bay is a capital anchorage. The lower part of the bed of the stream is rocky; and about 4 miles from the sea there is a pretty loch a mile in length. But salmon are prevented from having access to it by falls, a little way below. These are not perpendicular, but of a broken character, being shattered, as it were, into a number of separate falls. The lowest is scarcely any obstruction. That immediately above should be blasted out on the left bank. But the highest branch of the fall forms the most serious obstacle. Still, I think, that it would be quite possible to enable salmon to reach the loch. It is just a question of whether the additional sport to be gained would be sufficient to compensate for the expense incurred.

The Sanda is a small clear stream, with a considerable extent of good spawning ground. The Gour has but a brief course to the Linnhe Loch from the fresh water loch from which it issues. But both it and its parent loch frequently afford admirable sea-trout fishing. I have heard of one rod killing as many as 30 sea-trout of good size in a single day.

The Scaddle and Cona belong exclusively to Lord Morton, and run through his deer forest, which is washed on three sides by the waters of Loch Shiel, Loch Eil, and the Linnhe Loch. They are small rivers, having a drainage area of only 38 square miles. But at times they afford good grilse and sea-trout fishing.

The Creran has a drainage area of 35 square miles; rises on the south-west slope of Sgor-na-h'Ulaiddh, 5 miles from Ballachulish; and falls, after a course of 12 miles, into the head of the sea loch of the same name. The lower part of the glen through which it flows is finely wooded. Here it receives the Ure, and traverses Loch Fasnacloich. The salmon and trout fishing both in the river and in the Loch Fasnacloich are fairly good. In their answers to the printed queries, both Mr Stewart of Fasnacloich, and Mr Spencer Stanhope, lessee of the fishings and shootings, agree in stating that the fishings have fallen off, and impute this falling off to the fixed nets in the neighbourhood; and both agree in recommending a weekly close time from noon on Saturday until noon on Monday. From 35 to 40 salmon are stated to be the numbers caught annually by the rod, in the river and loch. The river is a late one; the first clean fish are got in May; the main take of salmon is in June; and the grilse run in June and July. Both agree in thinking that the Creran is far too small a river to have a District Board for itself, and recommend that it should be

combined with the Awe Board. There is a small hatchery connected with the Creran, formed by covering a disused cottage with a galvanised iron roof, and turning into it water from an adjacent burn; 30,000 fry have been turned out of it annually for the last three years. The great difficulty experienced is getting a sufficient number of salmon ova.

The Nell, Feochan, Euchar, and Add.

These three small rivers all run into Loch Feochan; the two former into its head about 3 miles from the town of Oban, and the latter into the south side at Kilninver. The Nell issues from a pretty loch of the same name, between 3 and 4 miles in circumference; and the Euchar flows out of Loch Scamadale, in which there is capital sea-trout fishing in the latter part of the season. It has a course of 4 miles before reaching the sea. About a mile from its junction with Loch Feochan, it runs through a rocky gorge, where there is a waterfall of several feet in height, beneath which there is a deep pool, which is a favourite resting-place for those heavy salmon which cannot succeed in passing it and reaching the loch. From 60 to 100 salmon have been taken in a day in former times from this pool. The Add rises in marshes in the north-west extremity of Glassary parish; traverses the valley of Glassary; the Moss of Crinan; and joins the sea at Inner Loch Crinan.

Scringing for Salmon and Sea-Trout on the West Coast.

The salmon fishing, and still more the sea-trout fishing, in all these Argyllshire rivers, and in many bays and smaller streams, for several miles along the coast, to the north and south of Oban, have been for a number of years past terribly injured by a species of poaching known in this part of the west coast as 'scringing.' Oban is the great centre of this illegal practice, and it is notorious that nine-tenths of the sea-trout sold in the fish shops, and consumed in the numerous hotels of this beautiful and fashionable resort during the summer and autumn months, are supplied by the scringers. They themselves have no title whatever to fish for salmon in the narrow seas and in the bays and sea-lochs off the mouths of salmon rivers, nor have they permission from any one who has a title. They deliberately and systematically break the law, and find law-breaking to be a more lucrative practice than the prosecution of their legitimate industry as fishermen for herrings, cod, haddocks, whiting, and other sea fish. This state of matters has been greatly encouraged by the fact that, until the recent reconstitution of the Board of the River Awe by the Court of Session, there had been no District Board in the neighbourhood of Oban for at least fourteen years previously; so that any watching or prosecution of the scringers had to be carried out by proprietors of fishings at their own risk and expense; and the cost of watching the rivers, bays, and sounds of a coast so deeply indented, and with so many islands, was found to be so great that private persons were unable to undertake it. Several memorials, concerning the evil effects of scringing and the modes of checking it, were addressed to the Home Office and to the Commissioners of Scotch Salmon Fisheries. But no adequate remedy for the evil has yet been found; though it is to be hoped that the newly-constituted Board of

the Awe, by means of its watchers searching and arresting the boats of the scringers when they come in to the quays at Oban laden with sea-trout illegally captured, may have some effect in checking this species of poaching. The 25th section of 'The Salmon Fisheries (Scotland) Act, 1868,' which is applicable to it, is about as stringently worded a section as could well be desired. It is in the following terms :—

In order the better to carry out the provisions of the Act of the 7th and 8th years of Her present Majesty, chapter 95, it shall be lawful for any water bailiff, constable, watcher, or officer of any District Board, or any police officer, to search all boats, boat tackle, nets, or other engines, and all receptacles, whether at sea or on shore, which he or they may have reason to suspect may contain salmon captured in contravention of the said last-mentioned Act, and to seize all salmon found in the possession of persons not having a right to fish salmon, and the possession of such salmon shall be held *prima facie* evidence of the purpose of the possessor to contravene the provisions of the said last-mentioned Act; provided also that the words 'the said recited Act,' contained in the second section of the last mentioned Act, shall be read and construed as if they meant and included this Act and the Acts recited therein.

I have often heard the opinion expressed in Oban, and in other localities where scringing prevails, that it is necessary, under this section, for the prosecutor to prove the *locus* where the fish were caught—a thing, in the majority of cases, quite impossible to do. But, with great deference to this opinion, I confess myself quite unable to see any ground for it under the wording of the section, which throws upon the scringers, as clearly and strongly as terms can do, the *onus* of proving that they got the fish legally. Confessedly, they have no right to fish for salmon or sea-trout except *outside* the narrow or territorial seas, as fixed and defined by 5 and 6 Vic. c. 95, that is outside one mile measured seawards from low-water mark, and the *onus* is thrown upon them by statute to show that they get them outside the one mile, not upon the proprietors of fisheries or the watchers of the District Board to prove that they were caught *inside* that limit. If, however, it shall be held that this view of the proper reading of the 25th section is incorrect, then the sooner a clause is added to it, to the effect that it shall not be necessary to prove the *locus*, the better.

The scringers operate with a strong herring net with a deep bag, sometimes fishing from the shore in regular net and coble fashion, sometimes in deep water, having the net between two boats, which make a wide sweep and then come together. They thus contravene the law in two ways—1st, by fishing for salmon and sea-trout without a title or permission from one who has a title; and 2nd, by fishing for and taking salmon by means of a net with a mesh smaller than that fixed by law for nets used for the capture of salmon. So far back as 1870, the evils of this practice of scringing were strongly set before Mr Buckland and myself, then acting as Special Commissioners to report on the effects of recent legislation on the salmon fisheries in Scotland; and in our Report of 1871 we suggested the combination of a number of the smaller fishery districts north and south of Oban into larger districts; the maintenance of one or two steam-launches for purposes of protection; and the assistance of the county police and coastguard to put down scringing. A great deal of evidence was laid before us bearing on the subject, and I may quote the following suggestions made by one of the largest proprietors in the neighbourhood of Oban :—

I wish to call the special attention of the Commissioners to the system of scringe and splash-net poaching, which prevails to a great extent along the

shores of the numerous islands and lochs on the west coast. By the laws already existing this is strictly illegal, but as in using these nets men do not require to land, and as, to obtain a conviction, they must be seen in the act of taking salmon or sea-trout, these laws are, in fact, totally inoperative. In this district I myself have between 25 and 30 miles of sea coast, and to protect this would require a fleet of boats and men out every night, and even that would not be effectual. During the summer months, salmon and sea-trout are openly brought by boats to the quays at Oban and other places nearly every morning for sale, and the only effectual way in which this most destructive system of poaching can be stopped, is by throwing on the seller the *onus* of proving that he got the fish legally. This might easily be done by giving each legal and chartered fishing station a brand or trade-mark for their boxes, and to stamp on all receipts given for fish sold, and then giving the police power to seize all boxes not so marked, and all fish for which the seller could not produce the stamped receipt of a legal fishery. This has already been done under the late Herring Acts in Scotland (since repealed), and under the Game Laws in England; and as this sort of poaching is confined chiefly to the west coast, the police on duty at the quays and shipping places would be able to stop the greater part of the illegally caught fish before they reached the market. Of course, the brand or stamp would be a trade-mark, and any person imitating it would be tried for forgery.

The Lochy District Board, whose district comes within these parts of the west coast which are exposed to the ravages of the scringers, made the following suggestions at a meeting held on 23rd January 1871:—

The formation of a staff of marine watchers provided with a steam launch to put down the depredations upon salmon committed by trawlers within the southern limits of the district of the River Add and the Point of Ardnamurchan.

This provision is necessary, owing to the prevalence of the capture of salmon by means of trawl and other nets in the waters of the Sound of Jura and Scarba, Loch Linnhe, the Sound of Mull, and the numerous arms of the sea opening therefrom and adjacent thereto. It is suggested that these watchers should be under the control of a general Board, and the cost defrayed from an assessment to be levied by that Board on all the District Boards rateably within the limits in question. The general Board to be composed of a representative from each District Board. The voting of the representatives and the election of a Chairman to be regulated in terms of the 18th section of the Act of 1862.

The last piece of evidence which I shall quote, bearing upon the subject of scringing, is from a letter from the late Mr Thomas Tod Stoddart, author of *The Angler's Companion to the Lochs and Rivers of Scotland*, which is printed (pages 100–103) in the Report of 1871, by Mr Buckland and myself. He there writes as follows:—

Illegal Fishing practised on the Coast of Argyllshire, &c.—Scringing, as it is termed, with mackerel or herring nets is largely practised near the mouths of the Argyllshire rivers. In dry seasons, during July and August, when the finnocks and sea-trout show a desire to enter the fresh water and swim about in small shoals close to the shore, ready to take advantage of the first freshet, great havoc is perpetrated among them, and that in a manner openly and without interference, by the coast fishermen. During the two last summers—those of 1868 and 1869, particularly that of 1868—I had many opportunities of seeing how industriously, and with what success, scringing operations were carried on in the neighbourhood of Oban and also at Salen in Mull, and of judging also how the practice acted to the prejudice of the river fishings in the neighbourhood—those, for instance, of the Awe, the Add, the Nell, the Feochan, the Euchar, the Aros, and the Knock or Baa. Every lawful morning, weather permitting, numbers of those fish were brought into Oban bay by boats ostensibly engaged in the capture of herring, mackerel,

lythe, and cuddies, and sold at an underprice through the town. Mr Baird, the lessee of the sea fishings in the neighbourhood, on my asking him why, seeing he had an interest in doing so, he did not interfere and put a stop to the practice, told me if he did so, it was at the risk of having his bag-nets cut and destroyed—the class of fishermen who carried on this system of poaching being both numerous as a body and lawless in their habits. As regards the sea-trout in the Argyllshire rivers, a great falling off in their numbers has of late years been observed, attributable, in a great measure, there can be no question, to this method of scouring their marine haunts.

When I visited Oban in the course of last summer, I found no diminution in the practice of scringing; and I was informed that there are at Oban and in the neighbourhood eight crews of scringers, averaging four men each. August is, in general, the best month for the scringers. I was told that the boats have often from 50 to 200 sea-trout each. Proprietors of salmon fisheries in the neighbourhood of Oban should be careful of letting any of their fishings to the scringers, or to any persons connected with them; because, if they do, all the fish illegally caught by scringing outside the limits of the regular fishing will be put down to the credit of that fishing, and it will be impossible to touch the poachers under the 25th section of the Act of 1868.

All the answers I received last year to the printed queries, as to increase or diminution in the take of fish on this part of the coast, agree that a material diminution has taken place, and impute that diminution, in a great measure, to the depredations of the scringers. One answer is, 'Takes of fish greatly diminished during last 10 years. I attribute it to illegal fishing both on coast and rivers;' a second is, 'Diminished owing to scringing;' and a third, from a considerable proprietor both of lands and fishings in the neighbourhood of Oban, 'Very much diminished, which I attribute to scringing and killing 'fish on the spawning beds.' The remedies suggested are to resuscitate Boards by authority of Sheriff or Court of Session; that constables, or water bailiffs be employed and paid by the Board to see that all illegal fishing be put down, and illegally killed fish forfeited; that it should not be necessary to prove the *locus* under the 25th section of the Act of 1868, when salmon or sea-trout are killed by unqualified persons; that the county police and the officers and men of the coast-guard may and should be authorised to assist in enforcing the provisions of the 25th section of the Act of the Salmon Fisheries Act of 1868, as was contemplated in a Salmon Fisheries Bill for Scotland, brought in in 1861 by Lord Advocate Moncrieff and Sir G. Lewis, the 62nd section of which provided, that—

The officers and men of the coast-guard service, and the superintendent and officers and men of the county police force, shall have the same powers and privileges as are conferred by this Act on any superintendent and water-bailiffs respectively, for enforcing and carrying into execution the provisions of this Act, and may at all times, when required, by any person having authority under this Act, aid and assist in carrying out the provision of this Act.

And that there should be inserted in any future Salmon Fisheries Act a section similar to the 2nd section of the Poaching Prevention Act, 25 and 26 Vict. cap. 114, which has been found extremely useful in preventing game poaching, and which provides, that—

It shall be lawful for any constable or peace officer in any county, burgh, or place in Great Britain and Ireland, in any highway, street, or public

place, to search any person whom he may have good cause to suspect of coming from any land where he shall have been unlawfully in search or pursuit of game, or any person aiding or abetting such person, and having in his possession any game unlawfully obtained, &c.

The Awe and Orchy.

The Awe is the largest and most important salmon river in Argyllshire. It has a drainage area of 271 square miles, and connects Loch Awe with the salt water Loch Etive. It is an almost solitary instance of the effluent of a great lake flowing, not from its foot, but from its side. The Awe issues from the broadest part of its parent lake, about 3 miles from the head, where it has a width of $3\frac{1}{2}$ miles; and after a course of 5 miles through the romantic pass of Brander, falls into Loch Etive at Bunawe. It is deep, still, and dark, and overhung on one side by lofty and almost perpendicular banks, during that part of its course nearest Loch Awe; while lower down it is a rapid and impetuous stream, with an average breadth of 45 yards, and a depth of from 3 to 20 feet. The largest *Salmo ferox* ever captured in Scotland was taken with rod and fly from the upper part of the Awe, not far from its exit from the loch, by the late Mr Muir of Innistray. It weighed within half-a-pound of 40 lbs. weight. The heaviest salmon are got in the Awe in autumn, it being a late water, like the great majority of the west coast rivers. It is a very good sea-trout as well as salmon river in autumn. The lowest pool in the river is regularly netted, and there used to be at the mouth a stell-net, with a special title to stell-net fishings from the Priory of Ardochattan. But this has been discontinued. There is a cruive on the Awe; but the cruive dike forms no obstruction to the passage of salmon, stretching only half-way across the river. There is a beautiful little loch about 8 miles in circumference, called Loch Avich, which is connected with Loch Awe by a small river a mile and a half in length. The trout in this loch are numerous, handsome, and well-flavoured. But salmon are at present prevented from getting access to it by an impassable fall, which could be made accessible without a great deal of expense. Pike, however, as well as salmon, would then be able to ascend to Loch Avich.

The salmon and trout in the Awe River and Loch have long been famous for their size and quality; and, from the remoteness of the district, and the difficulty of communication in former times, they seem to have been wonderfully cheap, as the following statement from Sir John Sinclair's Statistical Account of Scotland, published about ninety years ago, will show—

From the difficulty of exportation, the finest and largest salmon have been frequently sold to the inhabitants at sixpence each. The Loch Awe trout are unrivalled, perhaps, in any part of the known world. They are of the finest quality, and are found from the smallest size to 30 lbs. weight.

The Orchy is a beautiful and productive salmon stream, which rises among the wild mountains of the Blackmount Deer Forest; flows through Loch Tulla; and runs for 18 miles through picturesque and varied scenery, until it joins Loch Awe not far from the charming village of Dalmally. The innkeeper at Dalmally has a right to the fishings up to the foot bridge above the falls of the Orchy; the innkeeper at Inveroran has a right to the fishings from the foot bridge up

to Orchy Bridge; and from Orchy Bridge up to Loch Tulla the fishings go with the Blackmount Deer Forest. In all the three divisions there is good angling to be had in a favourable season. The Dalmally water below the falls is the earliest, being best in spring; while in summer and autumn the streams and pools above yield the finest sport. As a rule, the spring fish come right up to the long, deep, rocky pool below the falls, from which more than a dozen salmon have been taken in a day by a single angler. But there are a good many places between the bridge and Dalmally, where, by a little judicious pooling, several capital lies might be formed for salmon, so as to increase the angling capabilities of the river. The falls of the Orchy are 7 miles from Dalmally Hotel, and are about 20 feet in height. But, on the right bank, an admirable salmon stair or ladder has been formed in the rock, going round the falls, and enabling salmon to ascend easily when the river is in such a state as to induce them to run. Above these falls, the character of the river changes, and its bed becomes more rocky and not nearly so well calculated for breeding salmon as the fine stretches of gravelly spawning ground which characterise the Orchy between Dalmally and the falls. In the 5 miles of the river above the falls there are a great many capital angling streams and pools. Above the bridge of Orchy, the water is in several places shallow and stony, but there are several ledges of rock that might be utilised by a little building up with boulders so as to form pools, where none at present exist. The two best pools in the Deer Forest water above the Bridge of Orchy, are those known as the Island Pool and the Elbow Pool. The trout in Loch Tulla, from which the Orchy flows, are large in size, and in point of quality equal to those of Loch Leven. But they are not very numerous, which is probably to be accounted for by the number of pike in the loch. June, July, and August are the best fishing months on the Inveroran water; 15 salmon have been killed in eight days by one rod, and as many as 5 weighing together 60 lbs., in a single day. I was informed that in 1882, three rods killed 72 fish in the Upper Orchy, 49 of these being killed on the Inveroran Hotel water, and 23 on the Blackmount water. Two streams, in which there is much good spawning ground, fall into Loch Tulla. The larger of these is the water of Tulla running in on the north-east, and the smaller the stream from Loch Dochard, flowing in on the west.

The Etive and the Coe.

The source of the Etive is a small lake called Lochan-Mathair-Etive, 2 miles distant from Kingshouse Inn, and 970 feet above the level of the sea. From this the river flows past Kingshouse, thence through a grand and solitary glen hemmed in on both sides by steep and lofty mountains to Dalness, and finally falls into the head of Loch Etive, after a course of about 16 miles. There is a considerable tributary of the Etive called the Coupal, which rises in the wild ravine of Lairig Gartain, through which it runs for some distance. It then turns at a right angle, and flows parallel with the road down Glencoe, almost encircling part of the grand mountain called Buchaille Etive Morà. In this part of its course there is some good gravelly spawning ground; but below and nearer to its junction with the Etive, its bed is rocky. The distance from Kingshouse to Dalness is 8 miles, and the road passes quite close to the channel of the Etive. At Dalness, a little more than 4 miles above the mouth of the Etive, there

is a fall with picturesque surroundings, which entirely prevents the upward progress of salmon, and so blocks up many miles of good angling and spawning water. The fall is 20 feet high, and the deep and spacious pool below it is hemmed in by perpendicular rocks. It forms a most serious obstruction, very difficult to overcome. The best plan that occurred to me, after a careful examination of the locality, is to utilise a sort of natural channel which passes round the fall on the left bank of the stream. This channel is close to the river, and extends from the top of the fall—or rather falls, for there are several smaller ones above the main fall—to the pool beneath. By excavating this channel, and connecting its extremities with the river above the falls and the pool below them, salmon might be enabled to ascend to the upper waters. But this operation would cost a good deal of money, and any one undertaking it would require carefully to consider whether the salmonising of the upper waters would, or would not, repay the expense incurred. The length of the cut or channel required would not be much short of 150 yards. Above these falls, close to where a rough stone wall runs down to the river, there is another cataract, which would certainly impede, if it did not prevent the ascent of salmon. But on the right side, close to the bank, there is a channel in the rock which might easily be enlarged so as to allow of an easy passage.

For a mile and a half above this up to the keeper's house in the Black Mount Deer Forest, both sides of the river belong to Mr Stuart of Dalness, and in this space there are several fine angling pools. Farther up, he has only one side. About 3 miles above the falls at Dalness, there is another fall 12 or 15 feet in perpendicular height, which would entirely prevent the farther progress of salmon, even were they enabled to ascend to the foot of it. At present Mr Stuart's only salmon fishing is in the long, deep, and spacious pool below the falls at Dalness; but if these and the other obstructions above enumerated were made accessible, salmon would be enabled to ascend to Lochan-Mathair-Etive above Kingshouse, from which the river flows, and to its principal tributary the Coupal, and possibly also to parts of two streams that flow into it on the left bank from Corries in the Black Mount. It is perhaps worth noticing that Lochan-Mathair-Etive, the source of the Etive, whose waters flow into the western sea, is not more than a mile distant from Loch-na-Gannich, the source of streams which go to swell the ample volume of the Tay, and also that, if the Falls of Tummel were made accessible for salmon, this remote western loch on the wild moor near Kingshouse might be visited by salmon from the German Ocean.

The Coe, or Cona, rises 3 miles from Kingshouse Inn; traverses the famous Glencoe; and falls into the side of Loch Leven at Invercoe. Between 4 and 5 miles from its source it expands into a lake, about a mile in circumference, called Loch Treachtan. This loch is 231 feet above the sea, and is between 3 and 4 miles from the mouth of the river. Above the loch, the Coe is a small mountain stream; and near the steepest part of the road down Glencoe there are several waterfalls in its course, which completely prevent the ascent of salmon. Below Loch Treachtan, however, it expands into a nice little river, with many a good pool and stream well fitted for salmon and sea-trout. But between the foot of the loch and the inn, a mile farther down, there is a fall about 10 feet high, which effectually bars the ascent of salmon into Loch Treachtan and the fine pools between it and the fall. This

fall is not nearly so serious an obstruction as the fall at Dalness on the Etive, either in point of height or in volume of water, and I think the cost of making it passable for salmon and sea-trout would probably be repaid by the fishing in the river above and in Loch Treachtan. When I visited the fall in the end of last September, the Coe was in flood, and a considerable body of water was streaming over it. On the left bank of the river there was a long foaming rapid, terminating in a fall, then a broad square block of bare black rock, and then a straight ledge, over which a heavy volume of water was passing. The cheapest way of making the fall accessible to salmon would probably be to excavate a channel along the rock between the rapid and the perpendicular part of the fall, the said channel to be made on the side of the rock nearest the left bank of the river. The most effectual plan would be to place a subsidiary dam across the narrowest part of the stream, at a point between 30 and 40 yards below the fall, and so raise the water on the face of the fall. At this point the stream is from 6 to 7 feet across, and the rocks on either side rise—on the left bank from 10 to 12 feet, and on the right bank from 5 to 6 feet. If the water was raised 4 or 5 feet on the face of the main fall, salmon would easily pass up. Either concrete or the rocks on the spot might be used for making the subsidiary dam. A 'Macdonald Fishway' for this fall would probably cost from £150 to £200.

The Aray, Shira, Douglas, and Fyne.

These rivers all fall into Loch Fyne. The three first named belong entirely to the Duke of Argyll, while the Fyne is the property of Mr Callendar of Ardkinglas. The Aray is about 8 miles in length, and falls into Loch Fyne close to Inveraray. Salmon can get as far as the broad deep pool below the falls, 3 miles from the mouth of the river. These falls are not less than 40 feet high. They are not perpendicular, but broken into several separate cascades. But as the river was very low at the time I inspected it, it is quite possible that in heavy floods these separate cascades may be united into one sheet of falling water. The upper part of the Aray above the falls is in general very stony, with but little good spawning ground.

The Shira runs through a beautiful wooded glen, and close to its junction with Loch Fyne about a mile and a half to the north of Inveraray, it expands into the Dubh Loch, a pretty sheet of water about a mile and a half round, with a fine gravelly bottom in many places. Salmon and sea-trout frequent it in the season. I observed a stell-net fishing in Loch Fyne, in the bay near the mouth of the Shira.

The Douglas joins Loch Fyne 4 miles to the south of Inveraray. It contains salmon and sea-trout; and, like the Aray and Shira, is a late river, the best months being July and August. Near the bridge, on the high road across the river, there is a fall, where an attempt has been made to enable salmon to ascend. On the right bank there is a long rapid going round the fall; but there seemed to me to be too much white broken water in it, and I think that a resting-pool in the centre would be an improvement. There is a fine pool below this fall. The mouth of the river is somewhat more than a mile below the bridge, and there are some good angling pools between.

The Fyne is a larger and better salmon river than any of those above described. It runs into the head of the loch a little more than a mile from Cairndow Inn. Not far from its mouth, at the time of

my visit, there was a stell-net fishing in Loch Fyne. The Fyne runs through a beautiful pastoral glen, and there are many capital angling pools and streams in the lowest 6 miles of its course. Several of them are between the wooden bridge, a mile below the shooting-lodge, and the head of the loch, but the best pools are above the bridge. The chief tributary of the Fyne is the Red Burn, which is about half as large as the main stream at the point of junction. There are lofty and impassable falls about a quarter of a mile up this stream. I was informed that from 50 to 100 salmon and grilse, besides sea-trout, are taken from the Fyne, by the tenants who have the fishings and shootings, in an average year.

I may mention that one proprietor in the southern part of Argyllshire, in his answers to the printed queries, complains of the splash-net fishing for sea-trout in Loch Fyne:—

Both in this district (on the Sound of Jura), [he writes], and also on Loch Fyne, more especially the latter, large quantities of young salmon are killed by the splash-nets used for sea-trout, and sent into the market as sea-trout. On Loch Fyne the splashing commences about the end of January, and continues until autumn. There being no watchers, it is carried on quite openly.

John Scoular, salmon fisher, Inverneil, Ardrishaig, Loch Fyne, writes, as to increase or diminution of salmon during last sixty years—

About the same, from a thousand to two thousand fish, principally grilse; July and August best months.

About bag-nets he writes—

I think them very essential for the supply of good fish for the market, and ought to have every encouragement when fish are in season. My experience of fifty years is that salmon depreciate in value the moment they enter the rivers.

The Carradale, Ruel, and Echaig.

The Carradale is the principal salmon river in the district of Cantire. It has a course of 8 miles, and a drainage area 19·25 square miles. It falls into the Sound of Kilbrannan not far from Carradale House. It belongs entirely to Colonel Buchanan. It is frequented by salmon, grilse, and sea-trout. The Fishery District, assigned to the Carradale under the Salmon Fisheries Act of 1862, includes the whole east coast of Cantire; the bye-law, which came into operation 24th November 1865, declaring—‘That the limits of the District of the ‘River Carradale in Cantire shall be Skipness Point on north; Mull ‘of Cantire on south, including Davar and Sanda Islands; and that ‘the District shall consist of the portions of the sea coast and the ‘estuary to the river contained between the said points.’ The west coast of Cantire is within the District of the Ormsary and other rivers in and near Loch Killisport.

In his answers to the printed queries, Colonel Buchanan states, as regards the weekly close time, that it is ‘satisfactory, but not observed ‘by many fisheries;’ and as regards the take of fish, that ‘it has ‘decreased. Herring trawling in-shore disturbs the fish.’ Mr Thomas Eaglesome, Campbeltown, writes, as to take of fish—‘The take is as ‘good *on the average* as it was ten years ago. Our fish are all prime ‘when we commence (1st April); very few salmon, mostly grilse.

‘Nothing used on this coast but bag-nets. Fish can be taken with ‘bag-nets when no other way would be successful.’

The Ruel or Ruail rises at the head of Glendaruel, and falls into the head of Loch Ridden, an arm of the sea which opens into the Kyles of Bute. It is a late river, from July to the end of the fishing season being the best angling time.

The Ecknig flows out of Loch Eck, which is a little more than 6 miles long, and, after a course of 4 miles, falls into the head of the Holy Loch. It has a drainage area of 41 square miles. There are no obstructions on it, and it is frequented by salmon, grilse, and sea-trout. Loch Eck also contains the gwyniad, termed there the powan or fresh-water herring, and likewise a fish said to be peculiar to itself, and supposed to have been introduced in old times by the monks, who had considerable possessions in the district. It is called the goldie, and is from 4 to 5 inches in length. It has, when freshly caught, a rich golden colour, which undergoes a succession of beautiful hues until the fish dies. It appears almost transparent when lifted up in the hand, and the structure is very delicate. The Ecknig and Loch Eck are both late, the best angling months being from June till the end of the season. There is no District Board for any of the rivers falling into the Firth of Clyde, nor for the Clyde itself, and the natural consequence is that a great deal of poaching goes on unchecked. There is a private hatchery in the district of the Ecknig, established and maintained by Mr Duncan of Benmore and Kilmun. A hundred thousand fry can be hatched out annually.

Loch Lomond and the Leven.

Loch Lomond is 21 miles in length, and 6 miles wide in the broadest part. In some places it is upwards of 600 feet deep, and it covers an area of 21,000 acres. It is only 23 feet above the level of the sea; and a subsidence of less than 40 feet in the narrow neck of land between Tarbet and Arrochar would unite its waters with the sea at the head of Loch Long. It is fed by several considerable streams. The Falloch falls in at its head; the Inveruglas, Douglas, Luss, and Fruin on the west side; and the Endrick and several smaller streams on the east side. Salmon and sea-trout have access to all the streams named above; but their upward progress in the Douglas, Falloch, and Endrick is arrested by impassable falls. With regard to these falls, Mr Alfred Brown, the Secretary to the Loch Lomond Angling Improvement Association, writes as follows:—

On the Endrick the fall at Gartness is only passable in certain states of the water. It could be much improved by blasting. On Luss water there are many minor obstacles, but I do not think they need be touched, as they offer no serious difficulty. On the Douglas there is a very troublesome fall, completely barring the passage to very fine spawning ground. This fall has been blasted quite ineffectually. I think that either judicious blasting or the introduction of a stair or iron cradles would overcome it. There is a bad fall on the Falloch, cutting off many miles of fine salmon water. The Falloch is much frequented by salmon and sea-trout.*

* For a full account of the Leven; of Loch Lomond and the various species of fish frequenting it; and of the Loch Lomond Angling Improvement Association; see Appendix No. III. by Alfred Brown, Esq., Glasgow, Secretary to the Loch Lomond Association, author of *The Mollusca of the Firth of Clyde*.

The only effluent of Loch Lomond is the Leven, a broad navigable stream, which has a course of about 6 miles from the loch to the Firth of Clyde. Its name is said to be derived from two Gaelic words, *Le*, soft, and *avon*, a river; and its waters when they leave the loch are soft and clear, but, gradually as they receive the manifold pollutions from bleachfields and dye-works and other manufactures, and the sewage from the villages and towns in the populous Vale of Leven, they become thoroughly contaminated and filthy, unfit for human use, and deleterious to fish life; until, long before the Leven mingles its waters with the Clyde, it is little better than a broad dirty ditch, teeming with all kinds of pollutions. Yet, within the present century, the fishings on the Leven have been let for nearly £300 a year; and long before that date, the salmon and trout fishings in the Leven and in Loch Lomond were famous. In his *Northern Memoirs*, written in 1658, Franck speaks of the Leven as—

A rapid and peremptory river, that gulphs forth of the bowels of Loemon, replenished with trout, and beyond all measure, of incomparable salmon.

And at a later date, Smollett writes of Loch Lomond as—

Containing immense quantities of delicious fish, salmon, pike, trout, perch, flounders, eels, and powans, the last a delicate kind of fresh water herring peculiar to this lake.

In Sir John Sinclair's Statistical Account of Scotland, we are told, in the description of the parish of Bonhill, published in 1793, that—

The salmon it [the Leven] produces are reckoned among the best in Scotland.

And in the account of the parish of Dumbarton, it is stated that—

Salmon and trout are taken in large quantities. The former frequently sells as high as 1s. 6d. per pound tron, on the spot, seldom falls below 6d., and never below 4d.

Lastly, Mr Thomas Tod Stoddart, in his *Angler's Companion to the Rivers and Lochs of Scotland*, thus writes of the Leven:—

It contains salmon, sea-trout, and several of the fresh water species of fish. The fishings belong partly to Sir James Colquhoun of Luss, and partly to the Corporation of Dumbarton. The latter were let not long ago for £281 per annum.

At present, however, the fishings both in the loch and in the river have sadly deteriorated. Pollutions and poaching have produced their inevitable effects; and but for the praiseworthy efforts of the Loch Lomond Angling Improvement Association, the fishings would probably have become nearly extinct. There is no District Board for the Leven and Loch Lomond. Any protection given is afforded by the Angling Association, or by private proprietors. The consequence is that poaching is rife. Mr Brown, the Secretary to the Angling Association, writes as follows about the district of the Clyde and Leven:—

There is a general disregard of the law. Most of the fishing is done by poachers, who fish all the week long, even on Sunday, defying the law. On the pretext of catching herring and white fish, they harry the whole estuary (and especially the Dumbarton Banks), with nets of $\frac{1}{2}$ and inch mesh, killing the smallest 6 inch smolts, and selling them openly; the magistrates refusing to convict, save on such evidence as is nearly impossible to procure.

Mr Brown expresses himself as—

Not quite satisfied with the weekly close time. It should commence at noon on Saturday, and continue till noon on Monday. My chief reason for this is that the fish would get the benefit of clean water to its full extent, works on Leven beginning to lessen their discharge of abomination at noon on Saturday, and not being again in full blast till noon on Monday.

Mr Brown, in his answers to the printed queries, corroborates the view which I have previously expressed in this Report, that the general absence of District Boards on the west coast arises, not from the apathy of the proprietors, but from the poverty of the fishings:—

The absence of District Boards [he says] does not altogether lie in the apathy of proprietors. It generally arises on the question of cost. If funds were, even in part, provided, Fishery Boards would spring up everywhere. How can men, having *in cumulo* salmon fishings worth £200 or £300 per annum, be expected to have a board and pay a staff? The value of the fisheries here is so small, and the poaching and pollution so great, that it would take more than the gross annual value to pay for the necessary officials and watchers. The marketable fishings do not exceed £150 per annum; add to which about seven proprietors of frontage, equivalent to another £140. With such a valuation, I don't see how any sum raised by assessment could cope with pollution and poachers in a district where both are rampant. I suggest that, in a lawless district like the lower part of the Vale of Leven, and the Cardross Banks and Port-Glasgow Banks, we should have a water police, or boat's crew from the fishery gunboat, or coastguard, who should be charged with the suppression of poaching. This poaching leads to half the crimes in the county. The men leave their honest work, band together in gangs of fifty or sixty, with perhaps a dozen boats, and defy us to touch them. As a matter of public morals and safety, this state of matters should be put down.

In answer to the query relating to pollutions, Mr Brown writes—

Passing over the Clyde, Cart, and Kelvin, which are almost past praying for, we have the Leven, which is the entrance way to an immense angling district. This river is outrageously polluted by sewage and dyestuffs. The pollution is yearly increasing with the increase of manufacturing. The works have probably quadrupled in the last twenty years, and the pollution has kept pace with this increase. The manufacturers pretend that they settle the solid matter before discharging the water. But this is practically not the case. Even if it were, there still remain the deadly acids which are used (in lieu of chloride of lime) to clean Turkey red goods. These are not eliminated by settling ponds, and the result is that thousands of fish are constantly killed in dry seasons, and at all times fish are prevented passing up by the frightful state of the water.*

Messrs A. Orr Ewing & Co., one of the most important firms in the Vale of Leven, write as follows in their answers to the printed queries relating to pollutions:—

On the River Leven there are seven large public works and a considerable population. All the sewerage of the villages runs into the river, and a large quantity of water which has been made use of in the works. But great care is taken to prevent any gross matter going into the river, so that it is wonderfully pure, though now and then discoloured with colouring matter, which does not seem to be injurious to the fish. But the River Leven runs into the Clyde at Dumbarton Castle, which river is a mass of impurities.

It should be stated that most of the manufactories in the Vale of Leven are works of long standing, some of them having been in operation for more than a hundred years.

* For an analysis of polluted water taken from the Leven in 1870 and in 1884 see Appendices VI. and VII.

In the Leven District, the first run of salmon in any number is in May. There is a run of large-sized sea-trout in June, and the chief run of salmon and of the smaller-sized sea-trout is in July. The earliest grilse appear in the middle of June, but the main run is about the middle of July.

The Leven flows through the parishes of Bonhill, Cardross, and Dumbarton. In August last, I walked down its whole course from Loch Lomond to Dumbarton. For half a mile after it leaves the Loch I found it clear, bright, and unpolluted; but gradually within the next 2 miles it became thick and fetid in consequence of the various pollutions poured into it, and on several parts of the bottom there was a sort of scum resting. Some of the hecks connected with the works are not exactly in conformity with the bye-law; but, on the whole, the provisions of the bye-law are carefully adhered to. The works stop at 6 p.m. and have a ten hours' rest; so that the fish that come up with the evening flood go right up to the loch. The worst pollutions come from the print-works, as contradistinguished from the dye-works. There are no nets now on the Leven. But the old bothy for the fishermen, where the nets were worked until nine years ago, is still standing near the top of the tide-way opposite Dalquhurn Dye-Works. Of late years there has been a rapid increase in the various works on the banks of the Leven. In 1835, the wages paid amounted to £8800 per annum; in 1875, to £150,000. In 1835, the people employed were 350; in 1875, between 5000 and 6000.

The Clyde.

In point of drainage area, the Clyde ranks next to the Tay and the Tweed among our Scotch rivers, its watershed from the source down to Greenock being 1456 square miles, while its length from the head of the Daer to Dumbarton is 106 miles. The well-known Falls of the Clyde in the neighbourhood of Lanark—of which Bonnington Linn is 30 feet, Corra Linn 84 feet, and Stonebyres 76 feet high—have, of course, in all times acted as complete barriers to the progress of migratory fish to the extensive watershed and splendid spawning grounds above. But there are 40 miles of the main stream between the lowest fall and Dumbarton, and considerable tributaries, such as the Nethan, Avon, Calder, &c., in all of which salmon were at one time abundant; and a salmon still forms part of the arms of the City of Glasgow, though now, the immense and yearly increasing pollutions, from manufactures of all kinds and town sewage discharged into the river from Glasgow, have entirely destroyed the Clyde as a salmon river. Yet, less than a hundred years ago, salmon appear to have been common in the main stream and its tributaries. In his description of the parish of Dalzell, in Sir John Sinclair's Statistical Account of Scotland, the clergyman writes:—

The proprietor has a salmon fishery in the River Clyde, of which he avails himself only for family use, giving away to friends and neighbours what fish are caught more than necessary for his own table. The other fish found in the river, besides salmon and their progeny of grauls (grilse), fry, and parrs, are trout, lampreys, silver eels, pike, perch, roach, minnows, and a few horse or pearl mussels. In the River Calder, near its mouth, salmon are also found.

In the account of the parish of Dalsersf, the clergyman writes—'In the Clyde and Avon, salmon, trout, pike, eels, &c., are found.'

In the account of the parish of Lesmahagow, the minister writes—‘Salmon also, from the Clyde, go up the Nethan and even to the ‘Logan, and spawn there;’ and of the parish of Bothwell, it is stated that the Clyde there ‘is stored with trout and salmon, which are taken ‘with the rod or net.’ Then, farther down the river, below Glasgow, the clergyman of the parish of Old Kilpatrick, in the county of Dumbarton, tells us—‘The principal river is the Clyde, the boundary ‘of the parish on the south. It abounds with salmon, smelts, and ‘trouts, which are caught in great plenty.’ The clergyman of Erskine informs us that there are two or three salmon fisheries in the Clyde in this parish, prosecuted by means of net and coble, and he also mentions that ‘the right of catching salmon on most of the fishing ‘banks in Clyde, from Renfrew, as far down as the confines of ‘Ayrshire, belongs by ancient charter to the burgh of Renfrew.’ And with reference to this I may mention that, at present, the Clyde Navigation Trustees pay £200 a year to the burgh of Renfrew for damage due to its salmon fisheries by their operations on the channel of the river for the purpose of improving the navigation. Mr Stoddart, in his *Guide to the Rivers and Lochs of Scotland*, states with reference to these fishings belonging to the burgh of Renfrew, that the salmon fishings in the Firth ‘belong exclusively to the burgh of ‘Renfrew, and the average amount drawn from them annually, betwixt ‘the years 1814 and 1834, was no less than £4199, 1s.; about fifty years ‘ago, it averaged little more than one-fourth of the above mentioned ‘sum.’

The late Mr Frank Buckland inspected the Clyde from Glasgow to the falls about fifteen years ago, and wrote a short but interesting Report about it:—

The pollutions from Glasgow [he writes], a city which contains upwards of half a million of inhabitants, cannot possibly be worse than they are. At the time of my visit the water above the town bridge was ink black, and bubbles of fetid gas were coming up from the mill below, giving the appearance of a shower of rain falling. In spite of this and other matters to be mentioned hereafter, I made it my duty to examine the Clyde, and from what I have observed I by no means think it impossible that salmon may not be increased in the Clyde with care and attention, for they are as yet by no means exterminated, as is the case with the sister river, the Thames.

He goes on to give a description of the various weirs between Glasgow and the falls:—

A certain number of salmon [he says] are seen jumping at Blantyre Weir every year. They never appear till the first flood comes to clear out the river. There were few salmon seen this year, more the year before. Salmon never appear till towards the end of September.

Near the town of Hamilton there is a very steep and difficult weir at Barncleuth, on the Avon, a tributary of the Clyde. It is made of wood; the edges of the boards project over the pool below. In the west corner the weir forms an angle with the bank, and there is a slight depression in the weir. At this point I advise that a pass should be made by dividing out the angle into a series of pools.

Following the main stream up from Hamilton, there are many fine pools and spawning-beds admirably adapted for salmon-breeding, till we come to the three well-known falls of the Clyde—Stonebyres, Corra Linn, and Bonnington. The guide to the falls informed me that last year he counted fifty jumps of salmon in the rapids below the falls. They fall back and spawn about Crossford. Below these three falls there are between 5 and 6 miles of good spawning ground about here. Three or four days of spate bring the salmon up to the falls towards the end of October.

It is much to be regretted that these three falls of the Clyde are impassable for salmon, as the Clyde, I am informed, above them is a large river with a long course, and has abundance of excellent spawning ground.

I regret to report that the killing of parr with rod and line goes on very extensively in the Clyde. One man killed eight dozen parrs in one day. On another occasion between 7 and 8 lbs. of parr were killed by anglers opposite Dalziel, and 'sold for a fry.' The local idea is, that these parr are not young salmon. They are, however, always caught near the salmon spawning beds.

There is no kind of preservation in the Clyde. Many parent fish are cleeked on the spawning beds, especially in the Nethan. One man confessed to having poached 14 salmon last year, 21 the year before, and 43 six years ago.

There can be no doubt, therefore, that the salmon have not as yet entirely forsaken the Clyde. Those that attempt to ascend are—(1) driven back by pollutions, (2) kept back by the weirs which have not been made passable for them, (3) they are destroyed by poachers on their spawning beds, (4) their young, the parr, are killed by anglers.

It may be argued that the pollutions are against restoring salmon to the river. It is hoped that these pollutions will, gigantic as they at present are, at some time be removed; but even if they remain, the catchment basin of the Clyde is so vast, and since an immense body of water must come down the river in the winter, the pollutions in the lower part of the river must become sufficiently diluted to enable the salmon to ascend.

Again, the river naturally narrows just above Glasgow, and is narrow at Glasgow. A great body of water descending suddenly from the vast basin of the Clyde must soon sweep them out, more or less.

It is for this reason that I hope, that with the system of preservation properly carried out, the Clyde may again become a salmon river.

I am rather inclined to think that the hope expressed by Mr Buckland is somewhat oversanguine, namely, that the Clyde between Glasgow and the falls might, if properly protected, and with efficient salmon ladders placed on the weirs, again be made a productive salmon river. The population is too great, and has been too long accustomed to fish without interference; so that the cost of protecting this stretch of river would never be repaid by any probable increase in the number of salmon.

Then, likewise, the pollutions of the Clyde have greatly increased since Mr Buckland wrote his Report, and are consequently more likely to repel and drive back salmon to the purer waters of the Firth and the streams that flow into it; so that until some plan shall be devised and adopted by which the manufacturing refuse and the sewage of Glasgow shall not be poured into the Clyde, but shall be carried down to the waste lands on the sea-shore of the Firth, somewhere between Ardrossan and Ayr, or otherwise disposed of, it will be utterly in vain to attempt to make a salmon river of the Clyde between Glasgow and the falls. In my view of the question, the filth is a more fatal objection than the falls. Since Mr Buckland wrote, greater obstructions than these falls have been successfully overcome in localities where, as in the case of the Clyde above the falls, there is a great extent of fine angling and spawning water. In Norway, for example, the River Sire Salmon Fishing Company have, within the last few years, succeeded in opening up 50 miles of river and three large lakes, by making ladders, chiefly constructed of wood, over two waterfalls, one 28 and the other 89 feet high. The cost of these ladders was between £1300 and £1400.* And in America, the

* Such ladders would cost a good deal more in this country, as both wood and labour are cheaper in Norway than in Scotland.

Government of the United States recently voted £10,000 for the purpose of opening up the great Falls of the Potomac River, which are 72 feet in height, by means of a ladder constructed on what is known as the Macdonald system of fishway building. Colonel Macdonald, the inventor and patentee of this system, has been kind enough to send me his Report, together with the plans and specifications connected with this important undertaking.

I have the honour to be,

Your obedient Servant,

ARCHIBALD YOUNG,

Inspector of Salmon Fisheries for Scotland.

THE FISHERY BOARD FOR SCOTLAND,
25th March 1885.

NOTE I. TO APPENDIX G.

MEASUREMENT of DRAINAGE AREA of the Scotch Rivers and their Principal Tributaries, calculated and drawn up in 1863 from the best available sources of information, by JAMES LESLIE, Esq., C.E., Commissioner of Scottish Salmon Fisheries.

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.
Berwick, .	Tweed, {	Blackadder to junction with Whiteadder, .	66·25	207·5
		Whiteadder, minus Blackadder, .	141·25	
Mid Lothian, .		Leader, . . . . .	...
Peebles, .		Gala, . . . . .	...
		Lyne, . . . . .	...
		Tweed above Lyne, . . . . .	...
		Yarrow above Ettrick,	88·00	
Selkirk, . .		Ettrick above Yarrow	89·00	
		Remainder of Ettrick,	15·00	
Roxburgh, .		Teviot, . . . . .	...
		Minor tributaries in Scotland, . . . . .	...	192·0
		Portion in England, . . . . .	...	424·5
		Total, . . . . .	...	443·0
				269·
				1925·
Berwick, .	Eye, . . . . .	... ..	...	44·
Haddington, .	Biel, . . . . .	... ..	...	27·5
	Tyne, . . . . .	... ..	...	108·
	Esk, {	South Esk,	59·	123·
Mid Lothian, .		North Esk,	57·5	
		Remainder of Esk,	6·5	
				46·
W. Lothian, .	Leith, . . . . .	... ..	...	145·
	Almond, . . . . .	... ..	...
		River from Loch Lubnaig into Teith,	74·5	203·25
		River from Loch Katrine into Teith,	68·25	
		Remainder of Teith,	60·5	
		Forth above Teith, . . . . .	...	159·5
		Allan, . . . . .	...	77·0
		Remainder of Forth above Stirling, . . . . .	...	5·
Stirling, &c.,	Forth, {	Total of Forth above Stirling, . . . . .	...	444·75
		Devon,	78·	117·
		Minor tributaries between Alloa and Stirling,	39·	
		Total between Stirling and Alloa, . . . . .	...
		Carron,	84·	324·
		Avon,	89·5	
		Minor tributaries between Alloa and Queensferry,	150·5	
		Total between Alloa and Queensferry, . . . . .	...	885·75
		Total to Queensferry, . . . . .	...

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.
Fife, . . .	Leven, {	Ore,	59·25	153·0
		Leven above Ore,	77·25	
		Remainder of Leven,	16·5	
	Eden,	100·0
	Moonzie,	45·
Perth, &c., .	Tay, . {	Lochy to Loch Tay,	54·5	491·
		Dochart to Loch Tay,	180·5	
		Remainder of Loch Tay to Lyon, .	92·5	
		Lyon,	141·5	
		Remainder of Tay above Tummel, .	72·	
		Tilt to Garry,	89·5	661·75
		Garry above Tilt,	184·25	
		Remainder of Garry,	26·75	
		Tummel, minus Tilt and Garry, .	361·25	
		Bran, . . . . .	...
		Almond, . . . . .	...
		Ardle to junction with Ericht, .	74·5	474·
		Shee to do.,	74·5	
		Remainder of Ericht to Isla, . .	84·	
		Dean to Isla,	66·	
		Remainder of Isla to Tay, . . .	225·	
		Remainder of Tay between Tummel and Earn,	153·
		Earn,	346·
		Tay between Earn and Tay bar,	219·
		Total of Tay to Tay bar,	2510·75
Forfar, . . .	Lunan,	47·5
		Prosin,	40·	
		South Esk above Prosin,	64·	
	Sth. Esk, {	Remainder of South Esk,	141·	245·
	Nth. Esk, {	West Water,	52·5	238·
		North Esk above West Water, . .	117·	
		Luther,	57·5	
		Remainder of North Esk,	61·	
Kincardine,	Bervie,	48·5
	Cowie, .	... ..	...
	Dee, . {	Feguh,	102·	26·
		Gairn,	56·5	
Aberdeen, .		Remainder of Dee,	665·5	824·
	Don, . {	Ury,	124·	501·
		Remainder of Don,	377·	
	Ythan,	251·
	Cruen,	28·
	Ugie,	132·
	Rathen,	23·5

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.	
Banff,	{ Deveron, }	Isla,	112·	472·	
		Bogie,	78·5		
		Remainder of Deveron,	281·5		
	Boyne,	28·	
	{ Spey, }	Avon,	215·5		
Feahie,		80·5			
Elgin, . . .	{ Stream near Nairn, }	Tromie,	42·	1097·	
		Remainder of Spey,	759·		
		{ Lossie, Findhorn, }	...		...	109·
	Kintessock, Findhorn Loch,	346·	
	26·5	
Inverness,	{ Ness, . }	Moriston,	158·	670·	
		Garry,	152·		
		Remainder of Ness,	860·		
	{ Beauly, }	Affrick,	110·	373·	
		Cannich,	78·		
Remainder of Beauly above Farrar,		12·25			
Farrar,		122·75			
Ross and Cromarty,	{ Cromarty Firth, }	Remainder of Beauly,	50·	728·5	
		Sheen and Fannick,	152·		
		Conon above Fannick,	57·		
		Remainder of Conon above Rasay,	11·		
	Sutherland,	{ Dornoch Firth, }	Rasay,	98·	728·75
Orrin,			66·		
Remainder of Conon to Conon Bridge,			18·5		
Remainder of Cromarty Firth,			326·		
Caithness,		{ Fleet, Brora, Helmsdale, Langwell and Berriedale, }	Cassley,	70·25	728·75
	Oykell above Cassley,		109·75		
	Remainder of Oykell to Shin,		27·25		
	Shin,		220·		
	Sutherland,	{ Dunbeath, Wick, Thurso, Forss, Halladale, }	Remainder of Oykell to Carron,	9·5	48·25
Carron,			122·		
Remainder of Dornoch Firth,			170·		
Naver, . . . . .			...
Sutherland,		{ Fleet, Brora, Helmsdale, Langwell and Berriedale, }	71·
	165·	
	214·	
	72·	
	Sutherland,	{ Dunbeath, Wick, Thurso, Forss, Halladale, }	23·
...			...	104·	
...			...	162·	
...			...	58·	
Sutherland,		{ Strathy, Naver, }	108·
	48·25	
	186·5	
	

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.
Sutherland,		Borgie (from Loch Loyal), . . . . .	...	64'
		Kinloch (Kyle of Tongue), . . . . .	...	78'
		Stream from Loch Hope, . . . . .	...	81'
		Dionard or Grudie, . . . . .	...	81'5
		Inchard, . . . . .	...	15'75
		Loch Laxford, . . . . .	...	67'
		Inver, . . . . .	...	68'
		Kirkaig, . . . . .	...	80'
		Kennort, . . . . .	...	85'
		Ullapool (from Loch Auchall), . . . . .	...	43'
		Broom (head of Loch Broom), . . . . .	...	37'
		Strathbeg (Little Loch Broom), . . . . .	...	23'
		Grainard (from Loch-na-Shallag), . . . . .	...	58'
		Stream from Loch Fuir, . . . . .	...	33'
		Ewe, . . . . .	...	157'
Ross and Cromarty,		Stream at Kerrisdale, Gairloch, . . . . .	...	26'5
		Torridon (head of Loch Torridon), . . . . .	...	38'5
		Balgy, . . . . .	...	8'5
		Stream from Loch Lundie, . . . . .	...	10'
		Applecross, . . . . .	...	13'
		Kishorn, . . . . .	...	17'
		Carron (head of Loch Carron), . . . . .	...	75'
		Luing, } Loch Luing, { . . . . .	...	36'5
		Elchaig, } . . . . .	...	49'
		Shiel (head of Loch Duich), . . . . .	...	30'5
Inverness,		Glenelg, . . . . .	...	16'
		Arnisdale or Corran (Loch Hourne), . . . . .	...	18'
		Loch Hournehead, . . . . .	...	6'5
		Stream in Glen Gueeran, . . . . .	...	15'5
		Kilchoan (at Glen Dulochan, Loch Nevis) . . . . .	...	14'
		Morar, . . . . .	...	65'
		Aylort (head of Loch Aylort), . . . . .	...	26'5
		Moidart, . . . . .	...	19'5
		Shiel (from Loch Shiel), . . . . .	...	92'
		Stream (head of Loch Sunart), . . . . .	...	8'5
		Loch Aline, . . . . .	...	60'5
		Stream (near Torrana, Loch Linnhe), . . . . .	...	2'5
		Glenarbert (Sanda), . . . . .	...	7'73
		Ardgour or Gour, . . . . .	...	17'76
		Scaddle, . . . . .	...	37'83
		Glen Doilie Water, } head of Loch Eil, { . . . . .	...	12'
		Glen Tinitie Water, } . . . . .	...	11'
Argyll,		Lochy and Spean, . . . . .	...	441'
		Glen Nevis Water, . . . . .	...	29'5
		Leven (head of Loch Leven), . . . . .	...	76'5
		Creran (head of Loch Creran), . . . . .	...	34'5
		Etive (head of Loch Etive), . . . . .	...	38'5
		Awe (from Loch Awe), . . . . .	...	271'
		Stream (head of Loch Feochan), . . . . .	...	25'
		Euchar (Loch Feochan), . . . . .	...	24'5
		Add (west end of Crinan Canal), . . . . .	...	49'
		Ary (at Inveraray), . . . . .	...	22'5
		Shira, . . . . .	...	24'
		Fyne (head of Loch Fyne), . . . . .	...	26'
		Ruel (head of Loch Riden), . . . . .	...	33'5
		Eckaig (Holy Loch), . . . . .	...	41'5
		Carradale (Cantire), . . . . .	...	19'25

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.	
Lanark, &c.,	Clyde,	Douglas,	62·	748·0 123·0	
		Nethan,	30·		
		Avon,	109·		
		Medwin,	50·		
		Minor tributaries above Glasgow,	497·		
		Whole of Clyde above Glasgow,		209·	
		Kelvin,	106·5		
		Black to White Cart,	102·5		
		White Cart, minus Black Cart,			
		Endrick,	92·		
Ayr,	Garnock, Irvine,	Remainder of Leven,	193·	285·	
		Remainder of Clyde between Glasgow and Greenock,	91·	
		Whole of Clyde to Greenock,	1456·	
		94·	
		171·	
	Ayr,	Lugar,	86·	220·	
		Ayr above Lugar,	71·		
		Remainder of Ayr,	63·		
	Wigtown,	Doon, Girvan,	126·
			96·
Stinchar,		Lavery,	46·75	129·	
		Stinchar above Lavery,	50·5		
		Remainder of Stinchar,	31·75		
Pilanton, Luce,	29·5	
		73·	
Bladenoch,		Tarf,	42·5	141·	
		Bladenoch above Tarf,	50·75		
		Remainder of Bladenoch,	47·75		
Kirkcudbright,	Cree,	Minnock,	59·5	172·	
		Cree above Minnock,	44·5		
		Remainder of Cree,	68·0		
	Fleet,	36·5	
			
	Dee,	Deugh,	68·	359·	
		Ken above Deugh,	44·		
		Remainder of Ken,	87·5		
		Dee above Ken,	82·5		
	Remainder of Dee,	77·			
Urr, . . . .	...	...	7·
			
			
Dumfries,	Nith,	Afton,	17·		
		Cairn,	91·		
		Cargen,	22·5		
Carry forward,			130·5		

County of	Name of River.	Name of Tributary.	Area in square miles.	Area in square miles.
Dumfries, .	{	Brought forward, . . .	180.5	435.
		Remainder of Nith, . . .	304.5	
		Lochar, . . . . .	...	44.5
		Sark, . . . . .	...	26.5
		{ Kinnel, Annan above Kinnel, Remainder of Annan,	92.5	350.
			126.5	
			131.	
		Kirtle, . . . . .	...	80.5
		{ Liddle in Scotland, Liddle in England, Esk, minus Liddle in Scotland, Esk, minus Liddle in England,	114.5	
			9.	
			194.5	
			113.	
Island of Skye, . . . Mull, . . . Isle, . . . Arran, . . .	{	Portree, . . . . .	...	7.5
		Sligachan, . . . . .	...	17.
		Broadford, . . . . .	...	7.5
		Stenchal, . . . . .	...	4.5
		Aros (from Loch Erisa), . . . . .	...	22.
		Pennygowan, . . . . .	...	14.
		Laggan, . . . . .	...	28.
		Dougary, . . . . .	...	184.

NOTE II. TO APPENDIX G.

SALMON AND TROUT HATCHERIES IN SCOTLAND. A Paper read at the Half-Yearly Meeting of the Scotch Fisheries Improvement Association, held in Edinburgh, 26th November 1884, by J. BARKER DUNCAN, W.S., Hon. Secretary of the Association.

THE FISH HATCHERIES IN SCOTLAND, of which the Council of the Scotch Fisheries Improvement Association have, from time to time, given particulars in their Reports to the members, are as follows:—

1. *Howietoun Fishery.*—This Fishery, as is well known, belongs to Sir James R. G. Maitland, Bart., Stirling. It was commenced in 1878. From year to year it has been extended and perfected, so as to have gained a world-wide reputation as a fish-breeding establishment. Upwards of ten millions of trout ova are now annually incubated at this Fishery. Last season no less than 90,000 yearling trout were delivered from it to all parts of Great Britain and Ireland. Two consignments of trout ova and one of salmon were also forwarded successfully to New Zealand. Loch Leven trout (*S. levenensis*) is the speciality of the Fishery. American brook trout (*S. fontinalis*) and Common trout (*S. fario*) are also extensively cultivated. All eggs are eyed on glass grilles, experience having showed that the strongest embryos and healthiest fry are obtained by this method. The normal period eggs take to hatch is found (with water at 44·10 degrees) to be as follows:—*S. fario*, 71 days; *S. levenensis*, 72 days; *S. fontinalis*, 73 days; and *S. salar*, 77 days. Every twenty-four hours about one million gallons of water flow through the pond system of the Hatchery, which secures thorough aeration. There are no less than thirty-two fish ponds at Howietoun, and one botanical, the latter being in course of completion. There are, besides, four ponds at Craigend, and one of 9 acres at Goldenhove, which is used for rearing fish for the fish-monger. Very important experiments in hybridisation are being conducted at the Fishery. The staff required for the working of the establishment consists of a manager, three men, and four girls; and there are, in addition, constantly employed four labourers, and at least two carpenters. Mr J. R. Guy, secretary, Howietoun Fishery, Stirling, forwards, post free on application, Pamphlet on Stocking (Third Edition), Essay on Salmon Disease, and Papers on the Cultivation of Salmonidæ and the Acclimatisation of Fish.

2. *Solway Fishery.*—This fish-breeding establishment was established by its proprietor, Mr Joseph J. Armistead, in 1881, superseding Troutdale Fishery, near Keswick, Cumberland, which was established in 1868. It is situated near the Solway, in Kirkcudbrightshire. Hatching on glass grilles is also pursued at this Fishery, the percentage of loss being thus reduced to a minimum. Mr Armistead breeds at his establishment several kinds of trout, and char, salmon and sea-trout, grayling, and other fresh water fish. The hatching house is capable of holding several millions of ova, and at present contains apparatus that will hatch about one million. A meat house, ice house, filter house, and other buildings have also been erected; and these, with nineteen ponds in operation, and two in course of construction, occupy about an acre of ground. A museum and laboratory have been commenced to facilitate the study of the various details connected with the Fishery. The ova and fry estimated for distribution from the Fishery, during the season just commenced, is something short of one million, including British and foreign, the bulk of the latter coming from Norway. Small, as well as large, quantities of ova are supplied from the Fishery to enable

amateurs to try experiments in fish culture; and an illustrated catalogue of the apparatus required for conducting such experiments, and containing instructions, may be had on application by post. Mr Armistead also supplies a list of aquatic plants as a suitable and most important adjunct of fish culture; likewise proper food for trout, in the form of fresh water shrimps, mollusca, fish meal for feeding fry, &c. Mr Armistead's postal address is Solway Fishery, near Dumfries.

3. *Stormontfield Ponds*.—These Ponds were erected in 1853 by the then proprietors of salmon fisheries on the Tay. They are situated about 5 miles above Perth, on that river, and occupy, roughly, about 2 acres of ground. Under Mr Robert Buist, at that time the superintendent of the Tay Fisheries, a long series of experiments was conducted, proving many interesting points in the life history of the salmon. These experiments—well known as the “Stormontfield Experiments”—demonstrated, not only the practicability, but the profitability of rearing salmon artificially. The Stormontfield Ponds are now superseded by the Dupplin Hatchery (after referred to), but are still used for purposes of breeding and rearing. The breeding boxes number 360, and are placed in thirty parallel rows, in the open, on a gentle slope. Of these boxes, some 200 are being used for the present season. They are laid with gravel. The present intelligent superintendent of the Tay Fisheries, Mr Alex. H. Lumsden, states that, in his experience, the percentage of loss is very great as compared with that under the new system followed at Dupplin. The two rearing ponds at Stormontfield have been stocked, for this season, with about 20,000 fry from Dupplin Hatchery, which are doing well, and are now parr, about 2 inches long. The fry, fed on ground liver, are kept for about two years in the Ponds before being turned out into the river and tributaries.

4. *Dupplin Hatchery*.—This new fish-breeding establishment of the Tay District Board is situated at Newmill, Dupplin Castle (the property of Lord Kinnoull), Perthshire, on the River Earn, a principal tributary of the River Tay. It was instituted late in 1882. The hatching house is fed by spring water, at the rate of about 12 gallons per minute, which, however, is increased about a half more after the eggs are hatched. The gross hatching capacity of the boxes is estimated at 300,000. These are placed in four rows, fifteen being fitted up on the glass grille system, and five with the Wilmot tray, the whole at present containing, it is calculated, some thousand over the estimated capacity. It has been found that a much larger proportion of loss in eggs and young fish has marked the boxes with the Wilmot trays. But on the other hand, about a third more of eggs can be laid in a box fitted with the trays, which is an advantage if ova be plentiful. An attendant in special charge of the Hatchery keeps a daily account of loss in eggs and fry during the whole season. The loss for the past season amounted to $2\frac{1}{2}$ per cent. The number of days in hatching has been 64, on average; the earliest, 59—water temperature, 45 degrees. The fry are kept till about 40 days old, and then are distributed in the River Tay and its tributaries.

5. *Loch Leven Hatchery*.—The hatching house in connection with the well-known Loch Leven fishings (Kinross-shire) was erected in 1888 by the Loch Leven Angling Association, Limited, assisted by the proprietor of the lake, Sir Graham Montgomery, Bart. The cost of erection was £229, 19s. 2d. It is situated about 800 yards from the loch, beside a small stream. The water supply is got from a spring, about 600 yards from the house. With a temperature about 44 degrees, the period of hatching is from 68 to 72 days. There are 12 boxes—9 fitted up with glass grilles, and 3 with

Wilmot trays. Last season, about 180,000 eggs were laid down. The percentage of failure was exceedingly small. The fry were strong and healthy, and were distributed in the spring months in the several feeders of the loch. This season, about 220,000 eggs have been laid down, under the superintendence of Captain Hall, the popular manager of the Association, who proposes to turn out the fry into the streams running into the loch five or six weeks after hatching. Prior to the erection of a special hatching house for the Loch, Sir James R. G. Maitland, Bart., has, at different times since 1874, stocked it with Loch Leven fry and trout, bred at his own Fishery. By the kindness of his Lordship's secretary, Mr Guy, a table is appended to this paper, showing the effect of the Artificial Stocking of Loch Leven on the Catch, from 1875 to 1884 inclusive.

6. *Linlithgow Palace Loch Fishery*.—This Fishery was opened in May last. It belongs to Mr A. G. Anderson, fish merchant, Edinburgh, who has leased the loch for angling purposes from the Crown. A hatching house has been erected close by the Loch on a small stream. Two ponds are attached—one for adult trout, and the other for rearing fry. A third and larger pond, made of concrete, is in course of construction, for stock purposes. The entire Hatchery and ponds occupy about 2 acres. The hatching capacity is estimated at 600,000. For hatching, glazed terra-cotta troughs or tanks, and boxes covered with pitch, are used. The former do not give the same amount of space as the latter, in which are placed layers of perforated zinc trays—three or four to each box—thus providing a holding capacity of from 16,000 to 20,000 per box. Over 200,000 ova are already laid down for the season; but a large number of trout have still to be stripped. Last month 300,000 young trout, all strong and healthy, and measuring from $3\frac{1}{2}$ to $5\frac{1}{2}$ inches in length, were put into the loch. Mr Anderson finds the eggs hatch out in about 62 days, at a temperature of about 45 degrees. Last season the loss in hatching was about 8 per cent. So successful has Mr Anderson's Hatchery been that he has erected another house—made of wood (50 feet long and 7 broad), covered with felt—with an estimated hatching capacity of 300,000. Young salmon hatched from the ova, taken from a dead fish stricken with salmon disease, have thriven remarkably well. There is also a tank of ova in the Hatchery, taken from a female trout after being twenty-four hours dead, and impregnated with the milt of a male fully four days dead. These eggs have now been in the tank for about three weeks, and are looking healthy—the loss at present being only $1\frac{1}{2}$ per cent. A large arrival of "Schoodic," or "Landlocked" salmon ova, is expected at the Hatchery from Washington, U.S., and also a consignment of "Great Lake" trout ova from the Seewiese Fishery, Wurtzburg, Germany.

7. *Marquess of Ailsa's Hatchery*.—This private Hatchery is situated at Culzean, in Ayrshire. It was commenced in 1876. In that year a few boxes only were erected outside the vineries in the gardens at Culzean Castle, and put under the charge of the gardener. These boxes held about 85,000 salmon ova, which did pretty well; also 2000 char; 2000 *S. fontinalis*; and a quantity of common yellow trout. When the wind was high, however, it was found difficult to attend properly to the boxes outside, owing to the rippling of the water—any bad eggs being, from this cause, not easily seen. In the following year, therefore, the boxes were fitted up anew in the peach house on a much larger scale. They are now capable of hatching out 250,000 salmon ova yearly. The ova are got from the Doon, Stinchar, and Minnock—the fish being artificially spawned when netted—and the fertilised ova thereafter conveyed in cans to the Hatchery, a distance of 25 to 30 miles. For the last six years there have also been annually hatched 10,000 Rhine salmon.

In addition, char, *S. fontinalis*, and Loch Leven trout, have been hatched annually, and introduced into the hill lochs on the property. The eggs are hatched on gravel, with a constant supply of pure water flowing through the boxes; and very satisfactory results have been obtained. The fry are turned out into the River Doon immediately on absorption of the umbilical sac, being conveyed in cans a distance of 10 miles from the Hatchery, and put into the river about 8 miles from the sea. In two seasons, when ova was plentiful, over 300,000 ova were hatched. There are ponds in which the fry were at first kept till they were a year old, but these have been abandoned, as it has been found that the present practice of putting the fry out when the sac is absorbed is equally satisfactory. Mr Young, the Inspector of Scotch Salmon Fisheries, says in his Second Report, in which the Ayrshire Salmon Rivers are described—"Thanks to the enlightened liberality of the Marquis of Ailsa, the number of fish in the River Doon has been greatly increased by means of artificial stocking."

8. *Benmore Hatchery, Kilmun, Argyllshire*.—This Hatchery was constructed by Mr James Duncan of Benmore and Kilmun in 1874, after the plan of Stormontfield, for the purpose of stocking the River Eckaig with a larger class of salmon. The results were very marked, not only in the greater number, but in the increased weight of the fish caught. Prior to the introduction of the hatching boxes, the grilse caught weighed about $3\frac{1}{2}$ lbs.—rarely exceeding 5 lbs., whilst salmon weighed about 7 lbs. After the introduction of the boxes, grilse were seldom got under $5\frac{1}{2}$ lbs., whilst the heaviest salmon caught in the river in 1882, weighed $18\frac{1}{2}$ lbs. In Loch Eck, out of which the Eckaig flows, fish have been taken with the net weighing nearly 30 lbs. The capacity of the Hatchery is 100,000 ova. In the season of 1882, 80,000 young salmon from Tay and Tweed ova, after absorption of the umbilical sac, were turned into the river and tributaries. The boxes are filled to within a few inches of the top with coarse gravel, a layer of finer gravel above forming the bed for the ova. The loss has not exceeded 5 per cent. The Hatchery has been idle for two seasons—it being questionable if any permanent benefit can be had in the attempt to stock small rivers on the west coast under the existing Salmon Acts.

These, however, are not the only existing Hatcheries in Scotland, and there fall to be added to the above the three Hatcheries now to be mentioned.

9. *Lochbuy Fishery, Isle of Mull*.—This Fishery was established in 1878. It is the property of MacLaine of Lochbuy. Upwards of 50,000 ova of salmon, sea and other varieties of trout (*Salmon fontinalis*, &c.), are annually hatched. The proprietor, every year, imports eggs from Norway, Germany, Austria, and America. There are large ponds for the reception of fry and for keeping breeding stock. The speciality of the establishment is the breeding and rearing of salmon and sea-trout (spawned from the wild fish caught in the rivers on the property), for the re-stocking of the rivers and lakes on Lochbuy estate for sporting purposes. Large sheets of water on the estate, which were utterly untenanted by fish, now teem with splendid varieties, and afford magnificent sport to the angler. The proprietor not only stocks his own waters, but also sells ova, fry, or grown fish. Communications may be addressed to The Manager, Lochbuy Fishery, Isle of Mull.

10. *Aberdeen Hatchery*.—This Hatchery was established in the end of 1863 by the District Boards of the Rivers Dee and Don, and has been under the experienced management of Mr Alex. Adam, manager of the Aberdeen Salmon Company. It is erected in the fish house of the Salmon Company

where a quantity of ice is always kept. The average time of hatching is 107 days. There are 18 boxes made of slate laid in with gravel. From 15,000 to 20,000 are hatched out every year. The fry are distributed in the Rivers Dee and Don as soon as the umbilical sac is absorbed. The average loss in hatching has been found to be about $7\frac{1}{2}$ per cent. The fry are taken up the rivers from 10 to 20 miles, sometimes as far as 40 miles, in pails, and, by using a little ice on the way, the temperature of the water is kept down.

11. *The Moriston Hatchery, Inverness-shire.*—This Hatchery was erected in 1878 on the property of J. R. J. M. Grant, Esq. of Glenmoriston, for the purpose of stocking the River Moriston with salmon. The Moriston was not accessible to salmon until a pass was formed, a few years ago, at the falls, near Loch Ness. The Hatchery is situated 3 miles above the falls on a tributary of the river. There are 40 boxes laid with gravel, each large enough to receive 1000 salmon ova. Neither the glass grille system nor the Wilnot tray has yet been tried. An average of about 80,000 fry were turned out in each five years; the fry from the hatching of the spring of 1883 only being turned into a temporary pond, where they were kept until they were a year old. A few salmon are seen every year ascending the pass into the river, which is strictly preserved, it being thought desirable not to disturb the water yet, either by rod or by net, for the purpose of sport, or of collecting ova. Mr Grant is anxious to make the Moriston an *early fishing* river, and, with that in view, only takes ova from other early rivers. Some of the proprietors of these rivers in the neighbourhood are averse to disturbing their waters for the collection of ova, and the Fishery Boards, in the absence of unanimity on the question, do not see their way to give authority to take ova, as they are doubtful whether they have the power to do so under the present law, consequently the Hatchery has, unfortunately, not been filled during the last two spawning seasons.

It appears, after inquiry, that the Duke of Sutherland's Hatchery at Loch Brora, Sutherlandshire, and the Duke of Buccleuch's Ponds at Drumlanrig, Dumfriesshire—the latter so celebrated in connection with the experiments and observations conducted there by Mr Shaw, bearing on the life history of the salmon in its early stages—are not at present in operation. Information has been sought, but not obtained, regarding the artificial ponds which were at one time kept on the River Thurso; so that it is not known whether these ponds are still used. The same remark applies to the ponds which were, at one time, kept at Invershin, Sutherlandshire, by Mr Andrew Young, whose name ranks with those of Shaw and Buist as a close observer of the early life history and migrations of the salmon. The Hatchery sometime kept at Rosdhu, Loch Lomond, has, it is understood, fallen into disrepair, not having been used for a good many years. The two ponds, however, still remain, and, as boxes could be erected without much expense, this little establishment might, with very little trouble, be resuscitated. At Ravenscraig Castle, on the River Ugie, Aberdeenshire, a set of hatching boxes at one time was maintained. These having become rather antiquated, gradually fell into disuse. It was considered, latterly, that the Ugie fishings were not much benefited by the operations conducted. A hatching establishment existed at Tongueland, on the River Dee, Kirkcudbrightshire, for some eight or nine years prior to 1871, but, after the death of the then tenant of the fishings, Mr John Gillone, it appears to have been allowed to drop. His sons, however, it is understood, contemplate its revival. The District Board of the South Esk (Forfarshire) placed a few breeding boxes on a tributary of that river a good many years ago, but these apparently did not succeed, and do not now exist. It is not, however, pretended that this reference to hatcheries and ponds that

have once been in operation by any means includes all that have existed in modern years in Scotland, as it is believed that many private individuals have, at different times, made experiments in fish culture on a larger or smaller scale.

The foregoing paper has been written in order to bring together, in a convenient form, more especially for the information of the members of the Scotch Fisheries Improvement Association, some few details of what are believed to be the present Salmon and Trout Hatcheries in Scotland. The writer's best thanks are due to those noblemen and gentlemen who have, either directly or by their representatives, so kindly and frankly given the needful particulars.

[I have only to add to the above highly interesting paper, that there are four comparatively small Hatcheries besides those mentioned in it, which I met with in the course of my last inspection, and which are there described; one in Caithness, on the River Forss, where about 200,000 fry are hatched out annually; two in the districts of Eddrachillis and Assynt, in Sutherland, each capable of hatching from 40,000 to 50,000 fry annually; and one in the Creran District, where 30,000 are annually hatched out. There used to be a considerable hatchery at Brawl Castle, on the Thurso. But this has been discontinued, and there has been no artificial propagation there for five years.]

[TABLE.]

TABLE showing the Effect of the Artificial Stocking of Loch Leven on the Catch, from Year 1875 to Year 1884, both inclusive.

MONTH.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
Number of Trout	...	...	...	...	...	...	...	...	...	...
April, ...	209	126	68	800	813	1869	1594	1020	335	2319
May, ...	1981	1076	826	4233	6248	8141	3654	3063	3888	3230
June, ...	...	496	807	5063	4184	4686	5638	2619	6301	5232
July, ...	326	60	790	618	4707	1206	2019	986	1335	1884
August, ...	1856	728	2361	2281	5494	3322	3538	1331	3124	3311
September, ...	...	672	1240	784	599	132	93	114	129	208
	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>
Weight	...	...	...	...	...	...	...	...	...	...
April, ...	248	164	120	300	473	1756	1494	1198	353	1965
May, ...	2082	1110	851	2708	3442	7320	3553	2369	2998	2742
June, ...	1110	492	765	2373	3130	4685	5583	2280	4301	4319
July, ...	896	70	663	468	3844	1171	2185	1079	1296	1306
August, ...	1831	764	1870	1839	4724	3452	4303	1486	3595	9040
September, ...	...	670	1126	631	577	168	129	130	117	160
	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>
Average of each.	...	...	...	...	...	...	...	...	...	...
April, ...	1'139	1'301	1'764	1'000	1'381	1'939	1'587	1'169	1'050	1'846
May, ...	1'015	1'081	1'080	1'082	1'055	1'089	1'001	1'087	1'050	1'051
June, ...	1'066	1'155	1'043	1'067	1'048	1'000	1'000	1'063	1'050	1'051
July, ...	1'214	1'166	1'063	1'067	1'063	1'070	1'082	1'152	1'050	1'051
August, ...	1'192	1'062	1'063	1'067	1'063	1'089	1'197	1'116	1'150	1'051
September, ...	...	1'067	1'063	1'067	1'063	1'089	1'197	1'116	1'150	1'051
	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>	<i>Doe.</i>
Total	5093	3086	6092	13,319	21,045	19,405	16,491	9062	14,062	15,634
*Netted,	...	141	194	200	466	287	320	333	165	306
Total Weight	5093	3227	6286	13,519	21,491	19,642	16,811	9415	14,227	15,940
*Netted,	5668	3370	5385	8919	16,192	18,532	17,253	9018	12,742	13,832
Total, in lbs.,	...	235	234	361	508	309	414	608	248	400
Average,	1'113	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059
*Netted,	1'113	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059
Total,	1'113	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059	1'059
Fry turned in,	9000	22,000	70,000	45,000	None.	None.	None.	50,000	None.	150,000

Note.—Three thousand two-year-old trout were placed in the lake in 1882.

NOTE III. TO APPENDIX G.

LOCH LOMOND ANGLING IMPROVEMENT ASSOCIATION. A
 Paper read at the Half-Yearly Meeting of the Scotch Fisheries Improvement Association, 26th November 1884. By ALFRED BROWN, Secretary of the Loch Lomond Association.

I have been asked to say a few words about Loch Lomond, and the Association which has for so long struggled, under very adverse circumstances, to improve it as an angling water.

I may perhaps, in the first place, briefly refer to some of the physical aspects of the Loch, and to the peculiarities of its fauna.

As most of you are aware, Loch Lomond is a sheet of water about twenty-four miles long, narrow and deep at its upper or northern end, and gradually broadening and shoaling towards its southern end, where the River Leven empties its surplus waters into the Clyde. The basin in which the Loch lies is so little above the sea-level, that the subsidence of a few feet would again convert it into a salt water, or at least a brackish water, arm of the sea, a condition in which it undoubtedly existed at a very recent geological period; and it is probable that to this recent connection with what may be called the 'lagoon epoch' of this district may be attributed the unusually great specific variety of coarse fish with which its waters are stocked,—such fish as we find commonly in low-lying, fenny countries, and which are seldom found associated with the nobler sporting fishes of the salmon tribe.

These coarse fish to which I refer are no fewer than fourteen in number, viz. :—

- The River Lamprey (*Petromyzon fluviatilis*).
- The Sea Lamprey (" *marinus*).
- The Sharp-nosed Eel (*Anguilla acutirostris*).
- The Broad-nosed Eel (" *latirostris*).
- The Pike (*Esox lucius*).
- The Tench (*Tinca vulgaris*).
- The Roach or Braise (*Leuciscus rutilus*).
- The Minnow (*Cyprinus phoxinus*).
- The Loach or Beardie (*Cobitis barbatula*).
- The Flounder (*Platessa flesus*).
- The Rough-tailed Stickleback (*Gasterosteus aculeatus*).
- The Four-spined Stickleback (" *spinulosus*).
- The Ten-spined Stickleback (" *pungitius*).
- The Perch (*Perca fluviatilis*).

Then comes the Powan (*Coregonus cepedai*, Parnell), an erratic member of the salmon family; and lastly, the greater part of the British species of true Salmonidæ, viz., the salmon (*Salmo salar*), the bull trout (*Salmo eriox*), the sea-trout (*Salmo trutta*), and the common brown trout (*Salmo fario*). To these may possibly be added the Great Lake trout from Switzerland, and the brook trout from the United States, although, so far as I know, these two imported species have not thriven, or else have not maintained their identity. The so-called *Salmo ferox* is also stated to inhabit the lake; but, setting aside this very doubtful species, we have no less than nineteen specific forms which may be called indigenous, a number which, when contrasted with the meagre fish fauna of most of our fresh-water lakes in Scotland, is very remarkable. The most notable absentee is the Char, a fish inhabiting many of our Scottish lakes, especially those of an alpine character. It is probable that the comparatively recent maritime origin of Loch Lomond is a sufficient reason for the absence of this fish.

The food-supply for all this host is, so far as I have observed, by no means abundant. Small water beetles and the larvæ of Ephemera seem to form the most important part of it. Crustacea are singularly scarce, whilst of the shelled Mollusca I can only record, after diligent search, seven species, of which only one is in any abundance, viz., the ubiquitous *Limnaea pereger*; the other species are—two *Anodonta*, two *Planorbis*, one *Succinea*, and one *Cyclas*. In some of the muddy bays and backwaters, leeches and planariae abound, but they can hardly be said to form a feature in the general food-supply of the fish.

This Loch, so richly stocked with fish of all sorts, and lying in such close proximity to the most densely populated counties and towns of Scotland, stands in a unique position as to angling rights, for being navigable from the sea and under the control of a Government department, angling therein is, in a manner, a public right; that is to say, the public has an undeniable right to angle in Loch Lomond for non-migratory fish, so long as no trespass is committed in obtaining access to its waters, and so long as such angling does not impair or destroy the superior right of salmon fishing originally vested in the Crown.

Fishing for salmon and sea-trout is of course no part of the public right, but is claimed to be held by charter from the Crown (or by sub-charter from the original grantee) by several of the riparian proprietors, whilst other riparians have admittedly no such rights.

This complex state of matters has, on the whole, been a benefit to the angling public. It has, on the one hand, prevented the proprietors from absolutely closing the loch, even had they been willing; and, on the other, it has acted as a wholesome check on illegal fishing, as was shown the other day in Dumbarton Sheriff Court, when two men (one a notorious otter poacher) were convicted of fishing on Loch Lomond without leave, and having in their possession a fish of the salmon kind. No such prosecution would be raised against any fair angler, but in dealing with a known poacher the proverb applies—"Any stick is good enough to beat a dog with."

The Association which has taken upon itself the charge of the improvement of these waters as a public angling ground came into existence in 1859-60. Between that date and the present many changes in its constitution and management have taken place (*quorum pars magna fui*), but one radical idea has run through them all, to wit, that the angling on this great lake should be thrown open to the public absolutely without charge, whilst the necessary funds should be obtained partly by issuing angling tickets for the streams, but chiefly by subscription from gentlemen—whether anglers or not—who recognised the great public benefit which was being aimed at.

Shortly prior to the date above named, the whole salmon fishings in the Leven and the parts of Clyde adjacent fell into the hands of one proprietor—the late Sir James Colquhoun of Luss—who purchased them from the burgh of Dumbarton, and from him the Association leased the whole of the fishings, including the salmon fishing in the Loch and its tributaries, the conditions being that the Association should pay a rent of £120 per annum, and should remove all nets from the Clyde and Leven, and thus give the salmon a clear run into the loch, whilst the proprietor for his part undertook the watching.

At this time the fishing for sea fish in Loch Lomond was almost a blank. The severe netting of so narrow a stream as the Leven, together with universal and unrestrained poaching, had almost killed off the stock; but the action of the Association worked like a charm, and in a few years sea-trout had so multiplied that by 1863 baskets of a dozen to twenty of these fish were not uncommon to a single fly rod—such fishing as men now go to the Outer Hebrides to enjoy, and even there seldom get it!

In these years (1863-68) the Association may be said to have reached the

zenith of its success—fish were abundant, charges for boats and men low, and anglers were attracted to Luss from all quarters, whilst the number of associates reached nearly 200. In the latter of these years, however, the proprietor, for reasons which were doubtless satisfactory to himself, suddenly withdrew the lower waters from the Association, and three or four years later he resumed the entire fishery, placing the whole on lease to a tacksman, without giving the Association a chance of retaining them.

The result was most disastrous. In a couple of years the labour and care of ten were wholly undone, and in a few years more the fishings went back to the miserable state in which they were prior to the formation of the Association.

Seven years ago a reorganised Association again came to the rescue, picked up the wreck, and nursed what remained of the stock. At present there are about 130 members, who pay a guinea annually, besides 50 working men members, who pay five shillings. These latter, in return for this money, receive tickets authorising the holders to angle in the River Leven for salmon and sea-trout, the original intention being to turn men formerly poachers into honest anglers. In this we have succeeded beyond all expectation, and the watchers of the Association now report that they receive much assistance and information from these ticket holders. The fishing in the Loch is as usual thrown open free to the public, and I am glad to say that the amount of support received has been very encouraging, and the income has hitherto sufficed to meet the expenditure. A large increase in our membership would of course be very desirable, as the poaching requires to be dealt with much more strictly than can at present be done, and we should also like to do something towards stocking the water by artificial hatching.

The principal obstacle which now remains to the success of this scheme is the vastly increased pollution in the Leven; the dye-works there have increased by 'leaps and bounds,' and the pollution in probably a greater ratio. I show you here a bottle of Leven water as it issues from the Loch, and a bottle of the same taken at random as it passes the works of Messrs Stirling & Sons. In dry weather hundreds of salmon and sea-trout are found dead in the river—fat, healthy fish, quite fit for the table; in fact, the people collect them and sell them for food. These fish have been poisoned by refuse from the dye-works.

The young fry and smolts coming down to the sea in April to June must die by tens of thousands; but owing to their small size they escape notice in the turbid and filthy water, and their destruction passes unrecorded. Besides the actual death inflicted by these poisonous stuffs, they act farther to our detriment by keeping the fish in the cleaner waters of the tideway pending a freshet to permit them to pass up, and when in that situation they fall a prey to the ever-watchful poacher, who nets those lower waters on the pretence of catching herring or white fish.

After all the legislation that has taken place, it is most discreditable that two or three firms should be permitted to turn this beautiful and limpid stream into a foul sewer—a perfect *cloaca maxima*—in the short space of four miles.

With all these drawbacks, however, we have reason to be fairly well satisfied with what has been achieved. Fish are again abundant in the Loch, although, from climatic influences which prevailed all over Scotland, the two past years have yielded very poor sport; whilst in 1881 and 1882, with fewer fish in the Loch, excellent sport was obtained, no fewer than about 170 salmon and 2800 sea-trout having been brought to basket by anglers in those two years—no mean yield for a piece of open water in the immediate vicinity of our densest population.

NOTE IV. TO APPENDIX G.

REPORT by Colonel MARSHALL MACDONALD as to Erection of Salmon Ladders at Falls of Tummel and at Obstructions on River Ericht.

August 1884.

The Honourable Board of Salmon Fisheries for the Tay District.

In response to the request of your Honourable Board, communicated through Messrs Mackenzie and Dickson, Clerks of the Board, I left New York on the 12th of July *via* steamer for Liverpool, arriving at Perth on the 20th July. I was there met by Mr Dickson, who informed me that in consequence of the absence of members in attendance on the annual meeting of the Highland and Agricultural Society, it would not be practicable to convene a meeting of the Board before the 26th.

Acting upon the suggestion of Mr Dickson, I devoted Thursday and Friday (24th and 25th) to making a preliminary examination of the Falls of Tummel and the artificial and natural obstructions on the Ericht above Blairgowrie, in order that I might be prepared to suggest a definite plan of procedure to your Honourable Board at the meeting called for the 26th of July.

Mr Lumsden, local inspector, was detailed by Mr Dickson to accompany me, and I was thus enabled to go directly and promptly to all the points where obstructions existed.

A Report of this preliminary examination was submitted to the Board at the meeting held Saturday, 2nd August.

Acting upon the recommendations submitted, I was directed by your Honourable Board to prepare plans and estimates for a Fishway at the Falls of the Tummel; and for Fishways and Fishpasses over the dykes and other obstructions on the Ericht above the bridge at Blairgowrie.

Accompanied by Mr Young, the engineer officer designated by your Board, I visited the Falls of Tummel and all the obstructions on the Ericht, and indicated precisely the location of the Fishways required. The surveys necessary as a basis for detailed plans and estimates have all been completed, and the location of the Fishways and all auxiliary constructions are shown upon the maps and diagrams accompanying Mr Young's Report which is before your Honourable Board.

I will take up in order each of the points where obstructions exist, and indicate the conditions to be fulfilled, and the means by which this is to be accomplished.

1. THE FALLS OF TUMMEL.—The height to be surmounted here by a Fishway construction is about 16 feet.

By reference to Mr Young's map of the Falls of Tummel, it will be seen that two locations are practicable, *viz.*, one on the north side in the heavy ledge of rock which bounds the pool below the Falls on that side. This location is undesirable for several reasons, chiefly because it would deliver the water from the Fishway into the pool below at a point where salmon would not be apt to find it.

The other location is on the south side, and is such that the water from the fishway will be discharged into the pool below in a steady current, just at that point where salmon endeavouring to ascend the falls will readily find the entrance.

The Fishway, located as proposed and constructed as indicated in the plans and specifications, will be thoroughly protected from damage by floods and ice, and will be in effective operation at all ordinary stages of the river.

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By reference to the plans for the Fishway at the Falls of the Tummel, it will be seen that the amenities of the Falls will in nowise be interfered with. The lower end of the Fishway is let flush into the sloping face of rock that bounds the landing pool. For 27 feet it is in tunnel, passing through the ledge of rock which forms the south wall or abutment of the little Falls above; beyond the face of the Falls it is guarded from flood by a rough wall rising above the line of high water. This will be built so as to simulate a natural ledge of rock.

A visitor looking at the Falls from below will see nothing of the Fishway, but the shining band of rippling water drawn across the face of the rock.

To the visitor looking down on the Falls from above there will be the added interest of seeing the grilse and salmon passing up the Fishway.

The amount of rock-cutting in this location makes the cost per foot somewhat above the average for similar constructions.

Estimates, based on the data furnished by Mr Young, engineer, and Mr Ballantyne, carpenter, make the total cost, including expenses of survey and maps, but not including royalty, £274. These estimates are made liberal, to cover all possible contingencies, and in practice I think the work may be done for one fourth-less.

2. THE ERIEHT.—The obstructions on the Erieht, beginning in order with the first above the bridge at Blairgowrie, are as follow:—

1st, A dyke or croy about 8 feet in height from water to water. The lower side is rip-rap or pitch-faced, and has an inclination of about 30° (for plans, elevation, and section, see Mr Young's Report). This dyke acts as an obstruction to the ascent of salmon, not by reason of its height, but because the quantity of water passing over the dam in ordinary stages of the river being uniformly distributed, the whole length of the dam forms too thin a sheet to permit the salmon to pass. The remedy for this is to be found in concentrating in a narrow channel the overflow over a considerable length of dam. How this may be accomplished is indicated on the plans submitted by Mr Young. To make the construction plain, I have prepared a model, constructed to a scale of $\frac{1}{4}$ inch to the foot. This is transmitted with my Report.

This construction is applicable to any dyke or other obstruction not exceeding 6 feet in height.

It involves opening in the dam a notch or sluiceway 6 inches deep, and with an average width of 18 inches. Assuming the water to be level with the crest of the dam, the amount passing through the notch will be equivalent to $\frac{1}{4}$ of an H. P. for every foot of fall, or to one H. P. for every 5 feet of head, and the loss of power from keeping such notch open will be inappreciable.

Dyke No. 2, about 400 yards above the bridge, has a height of about 3 feet 9 inches from water to water.

Dyke No. 3, about 1300 yards above the bridge, is about 5 feet from water to water.

The same construction is applicable to dykes Nos. 2 and 3 as has been indicated for No. 1.

The cost of the construction in either case will be, according to Mr Young's estimates, about £20.

Between dykes 2 and 3 are falls about 9 feet high, locally known as the Keith. These will not, however, prevent the ascent of salmon should they be able to reach their foot.

At Ashbank is a dyke or dam about 9 feet from water to water. The stream below the dam is divided by an island, and the salmon in ascending take the channel on the Blairgowrie side. This is the concurrent testimony, and the location of the fishway has been determined with reference to this fact. The foundations will be in solid rock, and the constructions will be thoroughly

secure against damage by floods or ice. From the foot of the fishway a channel 2 feet deep, with an average width of 4 feet, will be opened to the deep water of the pool below. This will serve to direct fish ascending to the foot of the fishway. (For plan, elevation, and section see Mr Young's Report). Estimates based upon the data furnished by Messrs Young and Ballantyne, fix the cost, including expenses of survey and 10 per cent. for contingencies, at £119.

In this case, as in all others, the estimates are most liberal, and represent outside prices. I think it will be found in this, as in all other cases, that the actual cost under judicious management will be considerably less than the estimates.

The dyke at Westfield, about 2 miles above Blairgowrie, is the last obstruction on the river. The rise to be surmounted is about 12 feet. The location, plan, elevation, and sections are shown on the maps and diagrams accompanying Mr Young's Report.

In this, as in all other cases, care has been exercised to secure the utmost solidity of construction, and regard for the interest of mill-owners and operators has been shown in drawing upon them for the minimum supply of water requisite for the efficient operation of the fishways. The estimated cost of this is £201. This may be reduced 20 per cent. by giving the Fishway a slope of one in three instead of one in four, but I do not think it well in this case to build with a steeper grade than one in four.

MODEL FISHWAY.—By direction of the Board, Mr Ballantyne, carpenter, is employed in constructing a full-sized standard fishway, to serve as a type or model for similar constructions.

This is designed for the upper dyke on the Ericht, but may be adapted to any height by varying the number of intermediate sections.

I am glad to be able to report to your Honourable Board that both Mr Young, your engineer, and Mr Ballantyne, carpenter and builder, are fully posted in regard to the principles and detail of construction of the Fishways, and there can arise no practical difficulty in the application of the system to any location where a Fishway may be desired.

Although my engagement with the Board terminates with the rendering of this Report, I need hardly say that it will give me pleasure to contribute in any way I can to the development of the work, which I am assured will become general in time, and to keep you informed of any developments or modifications that may contribute to efficiency or economy in construction.

I have the honour to be,

Most respectfully, your obedient Servant,

MARSHALL MACDONALD.

NOTE V. TO APPENDIX G.

REPORT by JOHN YOUNG, C.E. and Architect, as to the Erection of Salmon Passes on the River Ericht, near Blairgowrie, and at the Falls of Tummel, near Faskally.

As requested by the Tay District Fishery board, I visited, along with Colonel Macdonald from America, the above named rivers, and took exact measurements and levels of the different weirs on the Ericht, and also of the Falls of Tummel, with a view to ascertain the amount of excavation and building

required at each place for fitting up and securely fixing the Macdonald Fishways, and also the cost of erecting the same. I have prepared plans and sections showing the nature of the work.

The upper weir on the Ericht at Westfield will have the bed for the Fishway, formed partly in excavated rock and partly in concrete.

The one at Ashbank will be almost entirely in excavated rock; and the other weirs, three in number, where they do not exceed 6 feet in height, will have channels formed in the face of the weir, to collect the water to form a stream and current enough for the fish to shoot up; and in the case of each weir a notch at the top of the weir averaging 18 inches wide by 6 inches deep, to allow the salmon to pass into the water on the upside of the weir.

At the Falls of Tummel the foundation of the fishway will be best formed on the Faskally side of the river, and will be almost entirely excavated out of the rock, and a part of it for a length of about 23 feet will be tunnelled. It will be so arranged that nothing will be seen from either side of the Falls except the rocks as at present, and only the channel for the fishway will be seen when looking right down upon it, or in looking up in the direction of its course. when it will rather have a picturesque effect than otherwise. Where any building is required, and that will be to a very small extent, it will be done in imitation of the native rock, so that the amenity of the Falls will not be in the slightest degree affected; and by hugging the side of the river the ladder will be in the best position to be protected from heavy floods of water, or any heavy body carried down by the current of the river.

The following is a probable estimate of the cost of the respective ladders:—

1. RIVER ERICHT.

1st, Westfield weir,	£183	
Add 10 % for contingencies,	18	
	<hr/>	£201
2nd, Ashbank weir,	£109	
Add 10 % for contingencies,	10	
	<hr/>	£119
3rd, Three other weirs requiring only sluiceway formed in face,		
averaging £20 each,	£60	
	<hr/>	£380

The above probable estimate includes cost of foundations, superstructure of fishways, and engineering expenses, but no charge for royalty, as Colonel Macdonald had arranged with the Board to give ladders for these free of royalty.

2. FALLS OF THE TUMMEL.

Including foundations and superstructure, engineering expenses,	
and royalty,	£314
Contingencies, 10 %,	30
	<hr/>
	£344

In compliance with the instructions of the Board, a full-sized Fishway, about 50 feet long, is in course of construction, under the superintendence of Colonel Macdonald and myself, and will be ready soon.

JOHN YOUNG.

Perth, 22nd August 1884.

NOTE VI. TO APPENDIX G.

STATEMENT by Messrs BUCKLAND and YOUNG, with regard to the Pollutions of the Dumbartonshire Leven in their Report of 1871 on the effect of recent legislation on the Salmon Fisheries in Scotland; and Analysis by Professor Anderson of Glasgow of Polluted Water taken from the Leven in 1870.

25th July 1870.

LEVEN (DISTRICT CLYDE AND LEVEN).

For centuries past the river Leven has been famed for its salmon fishings, the quality of which is considered very superior, and is reckoned such in the fish markets. The salmon bring a larger price than almost any other. The half of these fishings next the Clyde belonged at one time to the Corporation of Dumbarton, and they sold the same to Sir James Colquhoun about ten years ago. The other half, reaching to Loch Lomond, is the property of Sir James, and he is thus proprietor of the whole fishings from head to foot of the river.

Before the Turkey-red dyeing began to be extensively carried on at the different works on the river, which is about forty years ago, salmon were very plentiful, and the rents paid were high. In 1832 the yearly rent paid for the Corporation's half of the fishings was £230 per annum. After this their portion gradually fell off, and the last time they were let by the Corporation they got only £120 per annum for them, although they were let on a lease for three years. The upper half also let at a high rent, and so far back as 1785 it was let for £150 per annum. The rent of it also gradually fell off, and in 1845 it was so far reduced that £8 per annum was all that could be got for it. No part of the river has been fished with nets for the last ten years until the present season, and although the tenant's right of lease embraces the whole river Leven, as well as a portion of Loch Lomond, all the rent that could be got was £100 per annum. The lease extends over a period of seven years.

The following are the names of the different printfields on the river, viz :—

High Levenbank—Proprietors, Archd. Orr Ewing & Co.

Low Levenbank—The same proprietors.

Alexandria Works—Proprietors, John Orr Ewing & Co.

Ferryfield—Not in working operation.

Dalmonach—Proprietors, James Black, Drew & Co.

Dillichip—Proprietors, Archd. Orr Ewing & Co.

Cordale—Proprietors, William Stirling & Sons.

Dalquhurn—The same proprietors.

The stuffs after mentioned are used at these works, viz :—

Levenbank.

Chloride of lime.

Common soda.

Potash.

Pearl ash.

Marine acid.

Vitriol.

These are poisonous, and very destructive to the fish and fishings. They are used in great quantities.

Garancine and bullock's blood are also used at this field, but they have more a tendency to pollute than poison.

Alexandria Works.

The stuffs used here are almost similar to those used at Levenbank, and are used in great quantities.

Dalmonach.

(Bleaching Department.)

Chloride of lime.
Potash.
Common Soda.
Vitriol.
Marine acid.
Common lime.

These are all poisonous, and very destructive to the fish and fishings. They are used in great quantities.

(Dyeing and preparing Department.)

Madder.
Garancine.
Shumac.
Soaps
Galls.

These are not poisonous, but are pollutive.

Vitriol.
Marine acid.
Caustic sodas.
Pearl and potashes.
Oxygen or chloride of lime.
Chromes.

These are poisonous, and destructive to the fish and fishings. They are used in great quantities.

Dillickip.

There is little if any Turkey-red used here, although some of the stuffs allowed to escape into the river are both poisonous and pollutive.

Cordale and Dalquhurn.

The stuffs used here are much the same as those used at Levenbank and Alexandria Works, and are poisonous, pollutive, and destructive to the fish and fishings. They are also used in large quantities.

There is a constant flow into the river of poisonous and pollutive stuffs from the different works, but at certain times the discharges of the more noxious stuffs which have accumulated are allowed to escape in larger quantities. Every year great numbers of fish are killed by the poisonous escape from the works, and flounders and eels in immense numbers are destroyed. On Saturday the 9th current, about 100 sea and other trout and some grilse were killed, and a great number of them picked up along the banks of the river. These were all killed by a poisonous escape from the works. Within the last forty years flounders were plentiful in Loch Lomond, but as they migrate to the sea at certain seasons through the Leven, since the Turkey-red dyeing began to be extensively carried on they have become quite exterminated there.

There are a number of weirs attached to the different works, and projecting fully half way across the river, and these in a measure prevent the fish running up the river. They also do great harm to the fish coming down to the sea, and cause them to be driven into the lades. Some of the works have not even gratings on their lades, and the others have only put on theirs within these few days. Many fish are destroyed from the want of these gratings.

The state of filtration at the different works is quite defective, and it would be advisable to have an inspector appointed by Government to examine the filters periodically.

Besides the open drains and common sewers that are led into the river from the different works there are iron pipes carried into the centre of the bed of the river at several of the fields for taking off the most deadly and destructive liquids at any time when least likely to be detected, and where samples cannot easily be reached or obtained.

While the works are in full operation the escapes therefrom cause the river to be dyed all the colours of the rainbow ; but when there is a cessation of labour, such as on a holiday, Saturday afternoon, or Sunday, the water becomes perfectly clear. It is therefore in the power of the proprietors of the works on any occasion, such as when the Commissioners fix a day to inspect the Leven, to have the river comparatively free from pollution, so that the state of the river or samples of the water taken from it on the day when it is visited by the Commissioners is no criterion whatever of its polluted condition on ordinary occasions. What, therefore, is required is that proper filters should be erected at each of the works, and that an inspector should be appointed to examine them regularly. In no case should the poisonous and pollutive stuffs be allowed to run into the river without filtration.

With a view to keeping the river free from the poisonous and pollutive stuffs escaping from the works into it, the late Sir James Colquhoun took bonds in 1791 from the parties who then began printing on the river's bank, and in these bonds they bound themselves not to pollute the river by their operations. When the Turkey-red dyeing began they fell through this obligation ; and in 1821 legal steps had to be taken on the bonds to stop the damage being done to the fish and fishings from the poisonous and pollutive escapes from the works into the river, and afterwards the printfield owners were more careful in the discharge of the stuffs into the river. In the course of time they again got careless, and in 1846, when the poisonous escapes became very destructive to the fish and fishings, the Corporation of Dumbarton, then owners of the half of the fishings next the Clyde (since acquired by Sir James Colquhoun at a large price), Mr Ewing of Strathleven (an estate bounding the Leven opposite some of the works), and Sir James Colquhoun took measures to compel the proprietors of the printfields to filter the refuse of their works before allowing it to escape into the river, and these proceedings were only stayed on the printfield owners giving assurances that they would take care in future to have proper filters at their works. These proceedings took place on the bonds before mentioned. More recently Sir James Colquhoun remonstrated with the printfield owners as to the state of their filters, and although they promised to attend carefully to the filtration in future, they have failed to do so. The consequence is that the fish are killed in great numbers, and the fishings very seriously injured.

Perhaps it might be worthy of notice that the poisonous and pollutive stuffs now allowed to run into the river could be so filtered as to permit of their flowing into it in quite a harmless state. This, it is believed, could be done without incurring expense to the printfield owners. On the contrary, it is known that they would be gainers by it. An offer to filter in the manner indicated was actually made to some of the printfield owners, provided they gave authority to the person making the offer to use the refuse and waste stuffs for the purpose. For this refuse (presently escaping into the river) he was willing to give a large sum annually, and become bound that what now goes into the river in a poisonous and polluted state would afterwards be allowed to escape into it quite clear, so that it could do no injury.

Should the filtration above recommended not be considered a sufficient remedy for the pollution of the river by the printworks, a suggestion has been made that the whole poisonous and liquid escapes from the different works, as well as the sewage of Alexandria, Bonhill, and Renton, that presently

escape into the river, should not be allowed to enter it at all, but be carried off in pipes to some not very valuable land in the neighbourhood, where it might be allowed to filter and the sediment collected and sold. The sewage of these three villages ought in any event to be kept out of the river. The whole sewage of the town of Dumbarton is also allowed to run into the Leven, and it might be disposed of in a similar manner.

There is a chemical work at Millburn which runs off its refuse into a burn passing the works that carries it to the Leven.

In addition to the above there is an extensive paperwork recently started in Milton about a mile east of Dumbarton, and all the waste and poisonous stuffs escaping from it are allowed to run into a burn passing the works and conveyed by it to the Clyde. This paperwork is owned by Messrs Robert Biggart & Co.

Copy Letter from Professor Anderson to Robert Craig, Esq., Writer, Dumbarton.

Glasgow, 28th September 1870.

Dear Sir,—I enclose analysis of the samples of water from the Leven, which I have made as minute as the quantities sent permitted. The results are quite sufficient for me to form a very decided opinion, which I have expressed in the report; but should a complete analysis be at any time required, it is necessary to supply me with at least 2 gallons of each water. I think there can be little doubt that the state of the Leven must at times be very bad, but on this point you have, no doubt, abundance of evidence both from inhabitants and watchers, which, in the event of any legal proceedings, will be of much importance. I have heard that the fish in the river have entirely disappeared, or nearly so, and I can well believe that it is so.—I am, &c.,

(Signed) Thomas Anderson.

Report on the Composition of Fluids discharged from different Works into the River Leven.

I have carefully examined the samples of fluids discharged into the river Leven which you have sent me, so far as the quantity sent permitted, and have now to report as follows. In doing so I shall give, in the first instance, the results of the analysis in each case, and shall finish with such remarks as appear to me to be justified by these results.

No. 1, sample taken from Laigh Leven Bank on 13th July 1870.

This sample was almost perfectly clear, only a trace of matter being in suspension. It has, however, a complex smell, in which sulphurated hydrogen could be distinctly recognised, accompanied by a greasy smell, and also that of decomposing vegetable matter. It was perfectly neutral to test paper. An imperial gallon of it contained.

Volatile matters,	2.88 gra.
Fixed salts,	2.80 „
<hr/>	
Total solids,	5.68 „

The fixed salts are perfectly white, and consist principally of alumina, lime, sulphuric acid, and chlorine, the latter in considerable quantity.

No. 2, sample taken from Dillichip Works 29th August 1870.

This sample is milky in appearance, and contains a considerable quantity of matter in suspension, which appears to be chiefly organic. It has no smell.

and is neutral to test paper. On burning evolves a greasy smell. An imperial gallon contains—

Volatile matters,	17.60 grs.
Fixed salts,	10.01 „
	<hr/>
	27.61 „

The fixed salts contain a large quantity of sulphate of lime, and chlorine is also abundant.

No. 3, sample taken from Dalquhurn Works 29th August 1870.

An opaque milky fluid, with a peculiar, unpleasant smell. The dry matter catches fire and burns, from the presence of an oily organic matter. An imperial gallon contains—

Volatile matters, „	45.52 grs.
Fixed salts,	44.56 „
	<hr/>
Total solids,	80.08 „

The salts consist of alumina, carbonate of lime, and a large quantity of alkaline chlorides.

No. 4, sample of water taken from Dalquhurn Works on 30th August 1870.

This fluid was almost perfectly clear. It has a slight smell, somewhat like that of turmeric, and its reaction is very faintly acid. A gallon contains—

Volatile matters,	12.96 grs.
Fixed solids,	14.80 „
	<hr/>
Total solids,	27.76 „

The largest constituent of the fixed salts is alum.

No. 5, sample taken from High Leven Works on 13th July 1870.

This sample is tolerably clear, and contains only a trace of suspended matter. It is perfectly neutral to test paper. An imperial gallon of it contains—

Volatile matters,	9.20 grs.
Fixed salts,	24.08 „
	<hr/>
	33.28 „

Pretty clear. Inodorous, but containing a small quantity of suspended matter. The fixed salts contain alum, traces of lime salts, with abundance of alkaline, chlorides, and some sulphates.

No. 6, sample flowing from Dalmonach Works, 24th August 1870.

This sample has a purple colour and a faint smell of chloride of lime. It contains but little suspended matter, and is neutral to test paper. It emits a pungent smell when the dry residue is burnt, and the ash partially fuses. A gallon contains—

Volatile matters,	12.96 grs.
Fixed salts,	15.86 „
	<hr/>
	28.82 „

The fixed salts contain alum, lime, and chlorine in large quantity, sulphuric acid to a smaller extent, and traces of lead.

No. 7, sample flowing from Cordale Works, August 18, 1870.

A thick, muddy fluid containing a good deal of solid matter in suspension with a dirty bluish green colour, a distinctly acid reaction, and a smell like that of sour starch. The imperial gallon contains—

Volatile matters,	43.44	grs.
Fixed solids,	71.28	„
		<hr/>
Total solids,	114.72	„

On evaporation to dryness the residue has a brown colour, and on burning evolves a smell like that of burning starch. The ash, which is perfectly white, contains alum, chlorine, sulphuric acid, and a very appreciable quantity of lead.

No. 8, sample flowing from Cordale Works, 26th August 1870.

This is a nearly inodorous green fluid, with a very small quantity of matter in suspension, and a distinctly acid reaction. The imperial gallon contains—

Volatile matters,	88.8	grs.
Fixed salts,	51.76	„
		<hr/>
Total solids,	140.56	„

On evaporation to dryness the residue becomes partially fluid at 250° Fahr., and on burning emits a peculiar smell, which leads me to suspect that it must contain some urine. The ash contains lead in small quantity, much lime and chlorine, and a small quantity of sulphuric acid.

No. 9, sample of fluid flowing from Cordale Works on 29th August 1870.

This fluid scarcely contains any matter in suspension, and is almost inodorous. The colour is yellow, and it is neutral to test paper. The imperial gallon contains—

Volatile matters,	4.16	grs.
Fixed salts,	14.92	„
		<hr/>
	18.48	„

The ash left on burning the solid residue of this water has a greenish yellow colour, which is converted into bright yellow by nitric acid. It contains lime, sulphuric acid, and abundance of chlorine. There is also a small quantity of chromate of potash to which the colour of the residue is due.

No. 10, sample flowing from Alexandria Works, 12th July 1870.

This fluid is thick and cloudy, has a smell like that of tallow, and a greenish colour. Its reaction is very faintly acid. An imperial gallon contains—

Volatile matters,	12.16	grs.
Fixed salts,	42.48	„
		<hr/>
Total solids,	54.64	„

On burning the solids emit a pungent and greasy smell, and the ash partially fuses. It contains a trace of lead, a little alumina, lime and sulphuric acid in abundance, and but a small quantity of chlorine.

No. 11, fluid escaping from Alexandria Works, 18th August 1870.

A white and milky fluid which looks as if it contained some kind of soap in

solution. It is faintly alkaline to test paper, and when evaporated to dryness it leaves a brown residue, which on burning gives off a smell similar to that emitted by soap under the same circumstances. An imperial gallon contains—

Volatile matters,	89.36	grs.
Fixed salts,	53.36	„
<hr/>		
Total solids,	142.72	„

The ash contains lime, chlorine, sulphuric acid, and caustic acids, all in small quantity, and its bulk appears to consist of clay or some other mineral matter which is not readily decomposable by acids.

No. 12, sample of water flowing from Alexandria Works, 24th August 1870.

This water contains in suspension a very large quantity of matter, consisting of a pint dyewood. The clear fluid has a yellow colour, and the whole has a strong smell, somewhat resembling that of turmeric. It is perfectly neutral to test paper. The imperial gallon contains—

Volatile matters,	348.20	grs.
Fixed salts,	41.44	„
<hr/>		
Total solids,	384.64	„

The ash contains the usual constituent of vegetable matters along with a faint trace of lead.

In forming an estimate of the amount of impurity contained in these samples, it is necessary for me to remark that the water of the river Leven, as it flows out of Loch Lomond, is of unusual purity, and, in this respect, approaches very close to that of Loch Katrine, the only difference being that the matters in solution are somewhat larger in amount, and somewhat exceed 8 grs. per gallon. It will be noticed that the sample No. 1 contains a very trifling quantity of impurity. Such a water would, under ordinary circumstances, be considered as being of high purity. It must be noticed, however, that the impurity consists chiefly of volatile or organic matters, and is mainly the vegetable portion of some of the dyestuffs which have been used in the works. This vegetable matter is of a more or less putrescible character, and is on that account more objectionable than the same quantity of purely mineral matter would have been. Still it smells of sulphurated hydrogen and decomposing vegetable matter, and must be considered as injurious to the stream, although I feel bound to say that if nothing worse than this were allowed to flow into the Leven there would be little ground for complaint. It is far otherwise, however, with the other samples analysed. All of these contain a large quantity of impurity, obviously consisting of the refuse from different processes of dyeing and calico printing, varying, of course, very much in amount, but rising, in the last sample to upwards of three quarters of an ounce per gallon, of which seven-eighths at least is organic matter. Some of these fluids are highly coloured by refuse dyestuffs, and all of them are more or less offensive to the sense of smell. In most instances, the larger part of the impurity consists of volatile or organic matter, derived in some instances from the dyewoods employed, and in others, from the weavers dressing in the fabrics which have been dyed.

I have directed attention more especially to these organics, because, from their liability to undergo putrefaction, their effect in rendering the water offensive is most striking; but it must be understood that the animal matters are many of them far from being innoxious. They all increase the hardness of the water, and, by doing so, render it less suitable for its primary uses; but

some of the substances used in dyeing and calico printing are actually injurious to health.

Of course the effect produced by these refuse matters must depend much upon the quantity which flows into the stream, a point on which I have no information, but, from what I know of the magnitude of the works, it must be very considerable. It must necessarily depend also on the quantity of water flowing down the river, and must therefore vary at different seasons of the year and with different states of the weather. It is conceivable that, in very wet weather when the quantity of water is large, the effect may be comparatively trifling, while in dry weather it may be sufficient to make the stream no better than a sewer. These are points which can be best enlarged upon by those who are conversant with the stream itself, and the mode in which the refuse matters are discharged into it.

I can most unhesitatingly express it as my opinion that all the matters submitted to me are injurious, some of them, no doubt, less so than others, but there can be no doubt that all of them should be excluded from the river and disposed of in some other manner. How this is to be done is a question on which I shall not enter, because it must, to a great extent, depend on the arrangement of the different works, and a variety of other circumstances with which I am not sufficiently familiar, but I have no doubt that some means of disposing of these matters may be devised.

(Signed) THOMAS ANDERSON.

28th September 1870.

NOTE VII. TO APPENDIX G.

ANALYSIS of Polluted Water, taken from the Leven in 1884, made by Dr A. P. Aitken, Professor of Chemistry, Edinburgh Veterinary College, Clyde Street, and Chemist to Highland and Agricultural Society.

Analyses of seven samples of water taken from various parts of the river Leven and sent to me by Professor Cossar Ewart 10th April 1885. The samples were contained in quart bottles, and marked as indicated below.

Sample No. 1, marked "Ewings, General River Water drawn 17th September 1884."

This is a sample of clear water, neutral to test paper, and having neither taste nor smell. It contains per imperial gallon—

Volatile matters,	.	.	.	.	.	.	2.3	grs.
Fixed saline matters,	.	.	.	.	.	.	2.2	„
Total solids,							4.5	„

The saline matter consists chiefly of soda and lime, chlorides and sulphates (chlorine = 0.45 grs. per gallon).

Sample No. 2, marked "A. Orr Ewing, Levenbank, drawn 18th September 1884."

This water is slightly cloudy from the presence of suspended matter which soon settles in the form of a crimson sediment. It is neutral to test paper and has neither taste nor smell.

It contains per imperial gallon—

Volatile matters,	.	.	.	.	.	.	5.9	grs.
Fixed saline matters,	.	.	.	.	.	.	5.3	„
Total solids,							11.2	grs.

The saline matter consists chiefly of chlorides and sulphates of lime and soda (chlorine = 1·2 grs. per gallon).

Sample No. 3 marked "J. Orr Ewing & Co., Levenfield or Croftengea, 17th September 1884."

This water is quite clear and neutral to test paper and without taste or smell.

It contains per imperial gallon—

Volatile matter,	.	.	.	.	.	1·3 grs.
Fixed saline matter,	.	.	.	.	.	3·7 „
						<hr/>
Total solids,	.	.	.	.	.	5·0 „

The saline matter when ashed has a slightly green colour, and consists of soda and lime, salts, sulphates and chlorides (chlorine = 1 gr. per gallon).

Sample No. 4 marked "Ferry Field Works 18th September 1884."

This water is turbid and of a lilac colour. It is neutral to test paper and smells of soap refuse. When evaporated to dryness the residue has a brown colour, and when ignited it emits a smell of burning tallow.

It contains per imperial gallon—

Suspended matter.						
Volatile matters,	.	.	.	.	.	5·9 grs.
Fixed saline matter,	.	.	.	.	.	2·1 „
						<hr/>
Total solids,	.	.	.	.	.	8·0 „
Matters in solution.						
Volatile matter,	.	.	.	.	.	13·2 grs.
Fixed saline matter,	.	.	.	.	.	11·3 „
						<hr/>
Total solids,	.	.	.	.	.	24·5 „

The ash has a yellow colour, due to oxide of iron. The saline matter contains iron, potash, soda, and lime, in combination with sulphuric and hydrochloric acids (chlorine = 2·3 grs. per gallon).

Sample No. 5, marked "Lifted under Matheson's Upper Works, near to the Lower Works, where I saw the sick fish 19th September 1884."

The water is clear or nearly so, with only a slight sediment. It is neutral to test paper and has a strong smell of sulphuretted hydrogen. When evaporated to dryness the residue is dark coloured, and this when ignited gives off a smell resembling burning leather.

It contains per imperial gallon—

Volatile matters,	.	.	.	.	.	2·3 grs.
Fixed saline matter,	.	.	.	.	.	3·0 „
						<hr/>
Total solids,	.	.	.	.	.	5·3 „

The ash is composed of chlorides and sulphates of lime and soda (chlorine = 0·9 grs. per gallon).

Sample No. 6 (a), marked "Matheson & Co., Cordale, 18th September 1884."

This is a turbid water, having a smell resembling sewage, and a deep pink colour, due to an abundant precipitate of alumina coloured with a vegetable dye.

It contains per imperial gallon—**Matter in suspension.**

Volatile matter,	15.7 grs.
Fixed saline matter,	2.5 „

Total solids,	18.2 „
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Matters in solution.

Volatile matter,	6.3 grs.
Fixed saline matter,	5.9 „

Total solids,	12.2 „
-------------------------	--------

The salts in solution are chiefly chlorides and sulphates of lime and soda (chlorine = 1.1 gr. per gallon).

Sample No. 6 (b), marked "Matheson & Co., 18th September 1894."

This water is almost clear, the slight sediment is of a greenish yellow colour. It is neutral to test paper.

It contains per imperial gallon—

Volatile matter,	2.8 grs.
Fixed saline matter,	12.2 „

Total solids,	15.0 „
-------------------------	--------

The fixed salts consist chiefly of chlorides and sulphates of iron, lime, and soda (chlorine = 2.2 grs. per gallon).

No. 2 is chiefly injurious from the presence of suspended matter impregnated with a vegetable dye.

No. 4 is a water which would rapidly prove fatal to fish immersed in it for any length of time.

No. 5 contains an exceedingly poisonous gas, which, in the amount present in the sample, would be almost immediately fatal to fish.*

No. 6 (a) and (b) are both dangerous waters from the presence of iron, alum, and dye stuffs, and are quite unfit for being inhabited by fish.

A. P. AITKEN, D.Sc.

CHEMICAL LABORATORY,

8 CLYDE STREET,

EDINBURGH, 18th April 1896.

* It is probable that the sulphuretted hydrogen in the sample has in great measure resulted from the decomposition of organic matter of animal origin polluting the water, and that it was not present as such in the water when drawn seven months ago.

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